# Logistics Integration in the Port Sector: the Case of Iran

By

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The research associated with this thesis abides by the National Statement on Ethical Conduct in Human Research of Australia and is approved (Ref: H0016624) by the Social Sciences and Human Research Ethics Committee of the University.

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**LIST OF PAPERS**

- Alavi, A, Nguyen, H-O, Fei J, Sayareh J, 2018, ‘Port Logistics Integration: Challenges and Approaches’, *International Journal of Supply Chain Management*, Vol 7, No 6 (in press).

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# DEDICATION

To my lovely parents

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## ABSTRACT

The competitiveness of a seaport highly depends on its efficiency, especially in terms of how its logistics operations are integrated with those of other logistics chain partners. Despite the well-articulated importance of ports and terminals in integrated logistics, research on the success factors of port logistics integration remains scattered. This study aims to identify key factors in port logistics integration and how logistics integration can be improved. To identify the key factors in port logistics integration, a review of the literature is conducted to cover studies in Scopus indexed journals on logistics, supply chain and port management for the period 2000-2016.

Based on the results of the literature review, a conceptual framework for port logistics integration is developed and applied to a study of logistics integration in the Iranian port sector. The Iranian port sector is chosen due to its critical role in the Iranian economy and seaborne trade, and lack of research on the port sector in this country despite its strategic location in the Middle East region. The study makes use of data collected from a survey and interviews of senior staff and managers from ports, terminal operating companies, freight forwarders, transport providers, port authority, shipping lines, customs and shippers in Iran.

Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) are applied to the data set of 212 observations to identify and analyse the key factors in port logistics integration and their relationships. The results of EFA and CFA indicate that the logistics practice, information integration, value-added services, logistics practices, organisational activities, resource sharing and institutional support are influential to logistics integration. In addition, it has also been found that logistics integration in the Iranian port sector is subject to a number of issues and challenges relating to infrastructure, operational/ technical, Managerial/ organisational, governance and policy, and sanctions.

Using Nvivo Software and data collected from 105 interviews, the results of the qualitative analysis revealed that the lack of integration and coordination between logistics chain partners, management/ organisational issues and infrastructural issues are among the most important challenges in port logistics integration. Moreover, infrastructural development, the participation of logistics partners in the port’s decision-making process, information and technology development, and integration of

procedures and systems are highly recommended as measures to overcome the above challenges.

Based on the findings of the quantitative and qualitative analysis, several implications, and recommendations for port management and policy makers are discussed. For example, ports need to foster close, collaborative relationships with logistics chain partners in information exchange, communication, logistics operations management, port development, and joint decision-making process. Furthermore, ports need to make effective use of existing information and communication technologies; for example, EDI, online transactions and real-time cargo tracking. Given the deficiencies in infrastructure and investment, institutional support is needed such as loans/microcredit and lease facilities. To a broader extent, port development needs to be aligned with that of rail and road transport as part of the transport and logistics system. The sector can also benefit from reform measures to make ports more competitive and to attract investment from private and international companies.

## GLOSSARY

AGFI: Adjusted Good of Fit

AHP: Analytical hierarchy process

AMOS: Analysis of a Moment Structures

CBI: Central Bank of Iran

CEO: Chief Executive Officers

CFA: Confirmatory Factor Analysis

CFI: Comparative fit index

CIS: Commonwealth of Independent States

CMIN/DF: Normed Chi-Square

CRM: Customer Relationship Management

CV: Coefficient of Variation

EDI: Electronic Data Interchange

EFA: Exploratory Factor Analysis

ERP:  Enterprise resource planning

FA: Factor Analysis

GFI: Goodness of Fit index

GP: Governance and Policy

ICT: Information and Communication Technology

IFI: Incremental fit index

II: Information Integration

IMS: Integrated management system

IN: Infrastructure

IoT: Internet of Things

IRISL: Islamic Republic of Iran Shipping Lines

IS: Institutional Support

IT: Information Technology

JCPOA: Joint Comprehensive Plan of Action

JIT: Just in Time

LI: Logistics Integration

LP: Logistics Practices

LPI: Logistics Performance Index

LSP: Logistics service providers

LSR: Length of Supplier Relationship

MIS: Material Integration Centres

MO: Managerial/ Organisational

MRP II: Manufacturing Resource Planning

MRP: Material Resource Planning

NFI: Normed Fit Index

OA: Organisational Activities

OT: Organisational/ Technical

PLI: Port Logistics Integration

PMO: Ports and Maritime Organisation

PO: Processes and Operations

RBV: Resource-Based View

RFID: Radio-frequency identification

RMR: Root mean square residual

RMSEA: Root Mean Squared Error of Approximation

RQ: Research Question

RS: Resource Sharing

SA: Sanctions

SCI: Supply Chain Integration

SCM: Supply chain management

SCP: Supply Chain Performance

SEM: Structural Equation Modelling

SI: Supplier Involvement

SPSS: Statistical Package for the Social Science

TEU: Twenty-Foot Equivalent Unit

TLI: Tucker-Lewis Index

TPL: Third-Party Logistics

UAE: United Arab Emirates

VAS: Value- Added Services

VTS: Vessel Traffic Service

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

# CHAPTER 1: INTRODUCTION

## 1.1. BACKGROUND

Recent changes in the service industry have led to increasing complexity within supply chains, underpinning the argument that logistics activities and practices are important parts of business strategy (Stock *et al.* 2000). Growing competition has motivated companies to not only expand their internal operations but also focus on integrating their suppliers into the whole value chain practice (Prajogo *et al.* 2015). In addition, the occurrence of unforeseen and sudden events is a characteristic feature of competition in today's world. Such events require prompt responses and bring substantial pressure to bear on managers to enhance customer value for their organisations. In fact, consistently, new customers seem to want access to better service, higher quality and lower costs. In this unpredictable market, integration is a major competitive response. In order to achieve reliability, excellence and functionality in any organisation, its consistent and coherent strategic operational objectives need to be created in order to reform traditional performance systems and promote open communications.

The basic concept of integration is founded on this principle. There is an operational interdependence between multiple entities or sub-systems and components in a system such as an international logistics system. The overall performance will be increased if this interdependence is efficiently set up and managed, and the components are interconnected to support smooth and efficient operations. This depends on the degree to which the entities (logistics actors in a logistics system) are properly set up in order to perform their functions smoothly in connection with other entities in the system. If any of the following systems are about to optimise itself without consideration of other subsystems, the overall system productivity will drop significantly. It should be noted that obstacles, problems and, in particular, integration costs should be considered. Therefore, every organisation should also pay close attention to their priorities and, based on profit and loss forecasts, identify the required integration rate and density (Armoon 2013).

In the course of integrated logistics, logistics activities that are sporadically distributed in different parts of the organisation are handled in a comprehensive management system. This system allows for integration in planning, implementation and monitoring. At the same time, advances in information technology and decision-making techniques, as well as seamlessly integrated performance measurement systems, cannot be neglected. Integrated logistics can be considered progress towards an integrated supply chain in today's competitive world (Mirabbasi 2012).

As shown by Panayides & Song (2013) and Song & Panayides (2008), the main gap in the literature is the lack of a comprehensive framework to measure different aspects of logistics integration, particularly in terms of the effects of logistics partners and the relationships between them (Ralston *et al*. 2015; Schoenherr *et al.* 2014). This gap is highlighted in similar studies in which logistics integration is still considered as a challenge due to the complexity and involvement of multiple organisations; hence, further investigation into the different factors and aspects logistics integration is needed (Mellat-Parast & Spillan 2014a; Pinmanee 2016; Bae 2012). For instance, the role of actors in the logistics chain has rarely been examined in logistics integration (Rezaei *et al* 2015). Furthermore, the role of organisational activities, institutional support and resource sharing, which are considered as important factors in integrating logistics activities, is yet to be been studied in the port sector (Pinmanee 2016; Alfalla-Luque, Medina-Lopez & Dey 2013).

In the Iranian context, there is no existent empirical study of logistics infrastructures and integration between logistics activities in the Iranian logistics industry and specifically in port logistics. On the other hand, long lead-times, the rigidity of laws and regulations, the inconsistency of information exchange between port supply chain partners and international sanctions are the most important challenges facing the Iranian port logistics industry (Eshghi 2013; Yousefi 2015; Yeganeh 2016). Moreover, the uncertainty of sanctions in Iran's future creates a high degree of complexity in its port logistics system, especially compared to other ports in the Persian Gulf. In effect, this has prohibited the transport of containers to Iranian ports and insurance sanctions, related institutions and organisational interventions. Based on the abovementioned gaps and challenges from both research and practical perspectives, it is necessary to develop a framework for logistics integration that specifically considers the Iranian context so that the issues in the port sector may be solved.

## 1.2. RESEARCH PROBLEM

Although logistics integration has been considered in the literature since the late 1990s, its foundations date back to the late 1960s when a system thinking approach was proposed as an alternative to Cartesian thinking (Mirabbasi 2012). Despite the increasing importance of integrity, and researchers' and industrialists' attention to this issue, the literature on logistics integration remains far from what it could offer to the freight and logistics sectors. The lack of agreement among experts on the topic could be because those interested in this subject have only considered it from their own perspective. In general, the concept of integration is based on the assumption that actors in a logistics chain are interdependent; if they act independently without coordination, their performance may not be optimal, affecting the overall performance of the entire chain.

According to the systems thinking approach (Robertson 2006), the main purpose of integrating the components of a system is to increase its efficiency. Logistics integration can help reduce logistics costs, time and service quality, which in turn helps improve the company's competitiveness and performance (Robertson 2006). This performance can also lead to the other aspects of supply chain performance such as shorter supply chain lead-time, quick and precise response to demand changes, the reliability of the firm, cost reduction and inventory levels (Robertson 2006).

Logistics integration is often needed for relationships within and between organisational integration and coordination of material and information flow in the logistics structure. Inter-organisational integration and coordination through information technology have become key to improving supply chain performance. Recent advances in information technology have enabled companies to effectively coordinate the physical flow of materials and the various types of information, such as demand, capacity, inventory and scheduling, in a supply chain management system. According to Barut *et al.* (2002), by offering information and new technologies, step-by-step coordination will be more feasible for companies in order to correlate their logistics activities. Three main benefits of logistics integration include faster response to final customer demand, lower inventory throughout the supply chain, and lower costs to expedite shipments which can increase the firm's competitive advantage (Armoon 2013). Daugherty *et al.* (1996) argue that successful integrated logistics management connects all logistics activities in a system simultaneously to minimise distribution costs and maintenance of service levels required by the client. Thus, successful integration should result in more efficient logistical operations. According to Bowersox *et al.* (1996), if final inventory processes, material handling and packaging are entirely integrated within the logistics system, material flow in the supply chain will benefit from the simplicity and speed. Better coordination is the result of integration, eventually leading to reduced risks and increases in the efficiency of logistics operations. Bowersox *et al.* (1999) argue that customer integration, internal integration, material service supplier integration, technology and planning integration, measurement integration, and relationship integration are critical items shaping supply chain integration. Meenakshi Sundaram and Mehta (2002) highlight the following advantages for an integrated supply chain:

- The achievement of group goals, in addition to individual goals, including the timely delivery of products at affordable prices;
- Better service and better-quality products of a more attractive price;
- The improved collaborative effort between members of the supply chain; and
- The improved satisfaction of and benefit to the final consumer.

A fully integrated supply chain could create a superior performance chain and improve competitiveness for each of its channels (Zeng & Pathak 2003). In companies that have attempted integrated logistics, the logistics executive managers have better performance in customer service and quality improvements, productivity improvements, reduction in costs, improvement in strategic focus, and reduced cycle times (Daugherty *et al.* 1996).

Growing competition has motivated ports to not only improve their internal processes (such as inventory management and process control) but also to concentrate on integrating their shipping, ports and distributors into overall value chain processes. Yet, according to Rodrigues *et al.* (2004), interrelationships among parties involved in logistics operations still remain unclear although previous frameworks have conceptualised these relationships as flowing from strategic guidelines and policies towards the structural support of operational processes.

## 1.3. Research Objectives

The main purpose of this research is to identify key factors in port logistics integration and how logistics integration can be improved in the Iranian port sector, in consideration of its challenges, outcomes and opportunities. This aim is divided into three main objectives:

- To identify the key factors influential in logistics integration;
- To provide an analysis of logistics integration in the Iranian seaport sector;
- To identify the challenges facing Iranian port logistics integration.

This study is comprised of three main parts. The first part reviews the literature on logistics/supply chain integration with the aim of identifying the key factors within the port sector and proposing a conceptual framework for seaport logistics integration. The second part applies the conceptual framework to analyse logistics integration in Iranian ports. Then, based on the results of the analysis, the third part discusses the challenges in Iranian ports and provides implications and recommendations to policymakers to promote logistics integration in the Iranian port sector.

The Iranian port sector has been selected as the target of this study for multiple reasons. First, the country is located in a strategic region in terms of accessibility to three waterways. The Oman Sea and the Persian Gulf in the south and the Caspian Sea in the north are ideal for the importing and exporting of goods and transportation of passengers by ship (Sayareh 2006). The potential for international connections that Iran’s location ideally facilitates should be taken seriously by policymakers, especially in regard to its economic prospects as it attempts to develop trade with neighbouring countries (Sayareh 2006; Miandoabchi & Nasab 2014). Logistics and transportation play a vital role in the Iranian economy, which relies on its imports and exports with the rest of the world for economic growth.

Second, despite many advantages associated with its strategic geographical location and oil resources, until recently, Iran has suffered from economic sanctions imposed by the United States and its allies (IMS 2015).

Third, all commercial seaports in Iran are owned by the government and operate under the management of the Ports and Maritime Organisation (PMO), which is also responsible for setting the infrastructure and superstructures for private operators to carry out their commercial operations (Sayareh 2006). Moreover, they are facing considerable challenges. According to Miandoabchi (2007) and PMO (2015), these include:

- Difficulties in managing the intersection between port-related transport and other transport networks in commercial ports
- Lack of access to ports by rail
- For important ports, lack of dry ports in order to reduce port congestion
- Lack of information integration between ports and in logistic networks
- The disintegration of ports and the customs system
- The rigidity of the laws and regulations governing the port sector and the presence of rival ports in the region
- Lack of coordination in (domestic and international) laws and regulations in the port sector
- Problems with tariffs in Iranian ports and a lack of coordination with rival ports
- The inconsistency of regulations and policies between the port organisation and local government
- Problems with integrating ports due to different policies in different Iranian ports

Thus, analysis of logistics integration in the Iranian port sector is expected to provide valuable results that can help improve the performance of the port sector and allows it to facilitate growth in Iran's international trade in the post-sanctions era.

## 1.4. RESEARCH QUESTIONS

To address the research objectives stated in Section 1.3, the current study seeks to answer the following primary research question (PRQ):

**PRQ: How can logistics integration in Iranian seaports be improved?**

The extant literature and past reports have indicated that Iranian seaports are facing problems regarding port logistics integration. Therefore, an empirical study is needed to consider those problems and develop a comprehensive framework to improve port logistics integration. The aim of this research is to analyse logistics integration as a whole concept and then apply to the Iranian seaport system providing a comprehensive understanding of and solutions to port logistics integration of Iranian seaports and considering the challenges and outcomes of implementing the logistics integration framework.

The above primary research question is further broken down into three secondary research questions (SRQ). The first one is:

**SRQ1: What are the key factors in port logistics integration?**

As will be shown in Chapter 2, a review of the literature on port logistics integration is conducted to cover studies as far back as 1987, when logistics integration and logistics strategy was introduced to the literature. This review provides an explanation of both logistics integration in a general context and in the port industry, effectively revealing the research gaps in port logistics integration. The lack of a comprehensive framework to measure different aspects of logistics integration (Song & Panayides 2008; Panayides & Song 2013) appears to be the main gap in the literature. To answer SRQ1, different aspects of logistics integration will be considered, and factors influential to logistics integration (specifically in the port sector) will be gathered and synthesised to develop a conceptual framework for port logistics integration.

The study's secondary research question is:

**SRQ2: What are the critical factors in logistics integration from the Iranian ports' perspective?**

The conceptual framework for port logistics integration developed in Chapter 2 is applied to study logistics integration in the Iranian port sector. This study makes use of data collected from a survey and interviews of senior staff and managers from ports, terminal operating companies, freight forwarders, transport providers, port authority, shipping lines, customs and shippers in Iran. To answer SRQ2, both exploratory and confirmatory factor analysis is conducted to identify critical factors in Iranian seaport logistics integration.

The study's third secondary research question is:

**SRQ3: What are the challenges facing Iranian port logistics integration?**

According to the literature, few studies have identified the barriers facing logistics and supply chain integration (Katunzi 2011). Therefore, this research question seeks to identify the challenges and obstacles in logistics integration in Iranian seaports and to discuss the implications and recommendations of such challenges for Iranian port management. To do so, both Likert scale and open-ended questions will be used to answer the research question and provide recommendations for port management and policymakers.

## 1.5. RESEARCH APPROACH

To answer the above-mentioned search questions, this study utilised a survey as its research strategy. Both qualitative and quantitative analyses were applied using Likert scale and open-ended questions. In order to collect data and respondent details, an administrative (internet/paper-based) survey was employed. The empirical data was drawn from senior experts, middle and top managers of Iranian port organisation as a focal firm in particular and other logistics chain actors related to the ports. According to Churchill (1979), construct validity measures the correspondence between a concept and the set of items used to measure the construct. This process starts with the assessment of content validity. One way to ensure content validity is through reviewing the literature and using expert opinions. During the research period, this process should be applied to make sure the constructs and measures have been selected properly. Testing reliability should be the next step before testing the whole model (Mohsenin 2014).

A conceptual framework for the study was developed following studies by Notteboom (2008), Song and Panayides (2008), Panayides and Song (2008), Panayides and Song (2009), Panayides and Song (2013), Wilmsmeier *et al.* (2015), Alfalla-Luque, Medina-Lopez and Dey (2013) and Pinmanee (2016). Following Panayides and Song (2009), this study considers four main factors in logistics integration, namely information and communication systems, value-added services, multimodal systems, and operations and supply chain integration practices. As noted by Notteboom (2008) and Almotairi and Lumsden (2009), this study also focuses on the logistics actors' integration. It aims to fill the three main gaps in the literature. First, it explains port logistics integration in the context of the Iranian port sector. This was covered in sections 1.1 and 1.2 and centred around the special characteristics of the Iranian economy (including the economic sanctions and their effects on the economy). The second aim was to investigate logistics integration from the partner (actor) view. And thirdly, the study seeks to examine the effect of other factors such as organisational, institutional, and resources integration which have not been sufficiently researched in the literature.

## 1.6. RESEARCH SIGNIFICANCE

Logistics integration is a crucial element in the transportation and logistics sector, especially in seaports due to their nodal role in international transport and logistics. A higher level of integration between parties involving in logistics operation helps improve operational efficiency as well as the competitiveness of freight and logistics providers. This further creates positive impacts on other elements of the supply chain and the economy. An efficient shipping system is influential in joining separate activities, as it includes one-third of the logistic costs and considerably affects logistics system performance (Tseng *et al*. 2005). Costs arising in the logistics and supply chain for a product consist of labour and capital costs among many others (Somuyiwa 2010). Accordingly, the transportation cost of port activities encompasses a relatively high proportion of the whole cost of port services. The costs of port slots are significantly high in Iranian seaports and considered relatively high in comparison to other ports in the world with the same conditions. For instance, in Shahid Rajaee port this cost is 43 USD per container, while this cost is 13 USD in Fujairah and 7 USD in Oman (Rahdar 2018). In the top six countries in the port sector, the duration of stops along the waterfront is 10 hours while the typical duration in Shahid Rajaee Port is more than four days (Saraji *et al.* 2004; Eshghi 2013; Yousefi 2015). On the other hand, the lack of competition in road and rail transportation, inefficient transportation vehicles and out-of-date aeroplanes contribute to existing drawbacks in the rail/road sector (IBFIRAN 2016).

Another importance of conducting this research is related to improving the efficiency of the cargo handling process between ships and inland destinations. For instance, there is considerable lead-time between receiving cargo and its release from the port and, in some ports, this process takes more than 12 days, causing excessive costs for the fixed price of each type of cargo. The cost of transporting export goods from Iran is between 18 to 25 percent in semi-processed products and 30 to 35 percent for raw products, while this cost is around 18 percent in developed countries. This is despite the fact that Iran’s fuel prices are among the seven lowest in the world (IBFIRAN 2016).

The rigidity of the laws and regulations governing port transportation is another important drawback in Iranian seaports. International sanctions, which were imposed on the country from 2003, also have had a large impact on the logistics industry. Banking sanctions and insurance sanctions for Iranian ships are examples of these impacts. Another problem in Iranian seaports is related to lower container terminal capacity. For instance, in 2014 the Iranian seaports' average capacity was around 5 million TEU, while this capacity for the UAE and China was 21 million and 82 million TEU, respectively. Based on the special characteristics of the Iranian economy and its ports, there should be many opportunities available to the Iranian port sector. This includes: improving the business environment; enhancing the financial performance of shipping companies; the possibility of increasing the market share of some consignments of imported cereals; the development of shipping services in domestic ports to ports throughout the world; reactivating the global network in the internal shipping industry; reactivating the stalled development projects that have been under sanctions; the possibility of attracting foreign investment to implement projects; the potential to attract foreign investment to implement projects; and the possibility of financing from foreign banks (IBFIRAN 2016). Given these, this study will consider specific Iranian issues that have a considerable impact on the port supply chain and its economy.

As will be shown in Chapter 2, existing studies emphasize the importance of and need for further research to identify the missing functions in port logistics frameworks. According to a study by Lagoudis (2012), it is clear that there are two specific gaps in the port studies literature: one is related to port security and the other is about port supply chain/ logistics integration. According to Tseng and Liao (2015) and Bae (2012), organisational and institutional factors have not yet been considered in port logistics integration studies.

This study seeks to make contributions from both theoretical and practical perspectives. From the theoretical perspective, this research aims to propose a conceptual framework to analyse port logistics integration. This new framework will consider the drawbacks and limitations of previous frameworks such as focusing on port logistics chain partners rather than functions to identify the level of integration with each partner. A close relationship between logistics chain partners and the integration of their functions and activities are important to the logistics system (Allen *et al.* 2010). Moreover, this study will consider the developments in each function in the literature and propose a comprehensive framework to fill the gaps.

From the practical perspective, the findings of the current study are expected to help Iranian port managers and policymakers in attaining a comprehensive logistics integration framework and improving the performance of their ports. The proposed model has the additional benefit of being generalisable to developing countries that have a similar infrastructure to Iranian seaports. Thus, the study addresses the fact that only few port studies have considered the global context (Panayides & Song 2008; Song & Panayides 2008; Panayides & Song 2009) and no empirical study has been conducted to verify the findings and applicability to a specific country or region in order to identify drawbacks and barriers.

## 1.7. THE ORGANISATION OF THE THESIS

This thesis is organised as follows. Figure 1.1 represents the organisation of the study. Chapter 2 presents a comprehensive review of the literature on port logistics integration in order to answer the first research question. It investigates the key factors for logistics integration in general, and for the port sector in particular, to form a firm base from which to approach the second research question regarding developing a framework for the Iranian port logistics. This chapter contains two main sections. The first section of Chapter 2 is related to the integration concept, logistics and transportation, and supply chain and logistics integration in the general context, which is related to manufacturing, agriculture, services and any other contexts. The second section of Chapter 2 focuses the review on logistics integration in the port sector, with emphasis on the different partners of the port logistics chain and the relationships between them as well as the functions that lead to integration in the port logistics chain.

Chapter 3 provides background information of Iran’s trade and maritime sector including infrastructural facilities and challenges facing port logistics. This includes general information about ports, facilities, capacity, logistics items and other issues that are related to the integration of logistics in the Iranian context. This chapter reviews the specific features and issues of Iranian seaports in order to support the development of the conceptual framework for port logistics integration to answer SRQ2.

Chapter 4 explains the research approach, strategy and methodology. The latter includes research design, survey questionnaire development, data collection, and analysis including both quantitative and qualitative analysis. The quantitative analysis applies exploratory factor analysis and confirmatory factor analysis, while the qualitative analysis is a content analysis of data collected from the interviews of industry experts.

Chapter 5 presents the results of the quantitative data analysis including descriptive preliminary analysis followed by exploratory and confirmatory factor analysis of data collected from the second and third part of the questionnaire. The analysis makes use of SPSS and AMOS statistical software. Chapter 6 presents the results of the qualitative analysis. It includes content analysis, validity and reliability check, data analysis results and discussion for each question.

Chapter 7 discusses the findings from the quantitative and qualitative analysis in Chapters 5 and 6. It consolidates and synthesizes the findings from the two data analyses' perspective, and based on that, presents the implications and recommendations for port management and policy makers. The chapter presents the answers of the study as a whole, to its research questions.

Chapter 8 summarises and highlights the key findings and evaluates their contributions as well as limitations, which lead to the discussion of the implications for future research.

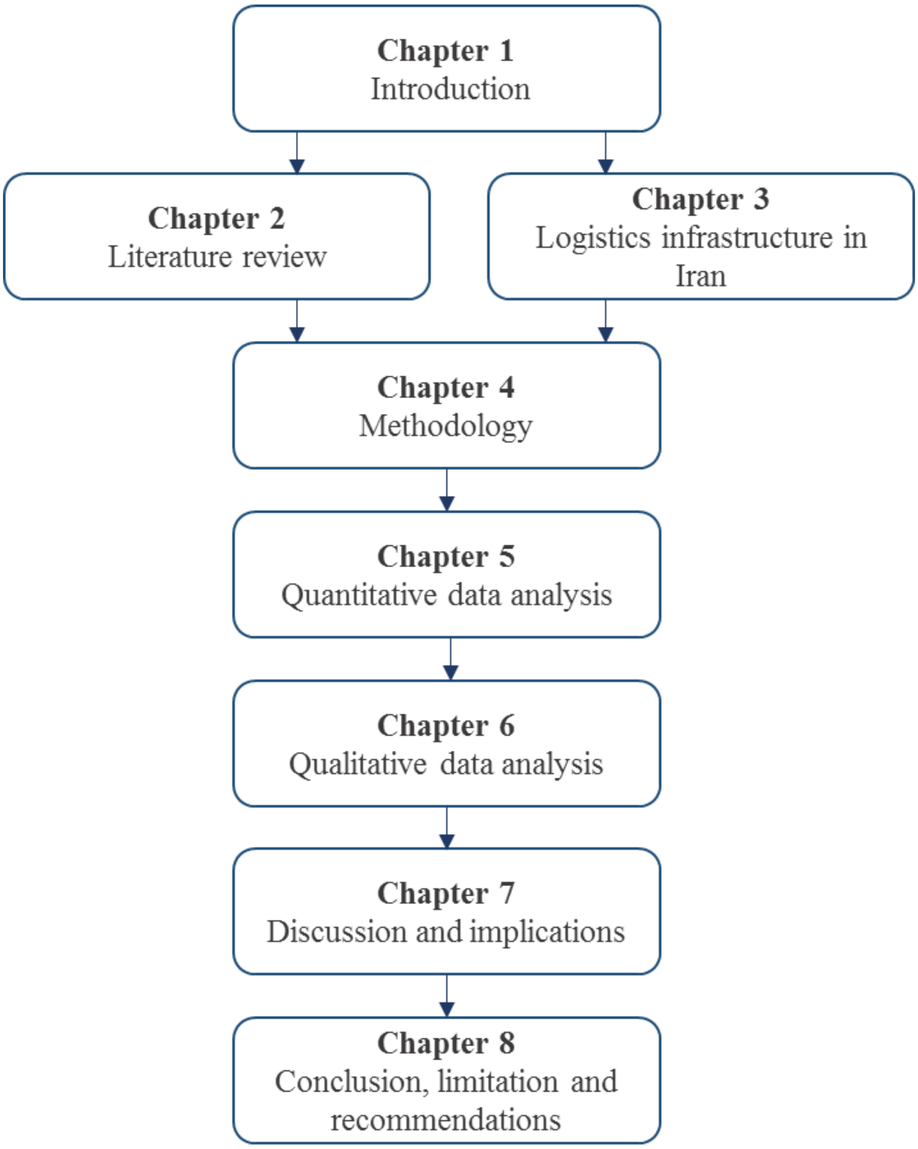


Figure 1.1. Thesis structure

# CHAPTER 2: LITERATURE REVIEW

## 2.1. INTRODUCTION

Recent changes in global production have led to the increasing complexity of supply chains and highlighted the critical importance of logistics efficiency to port competitiveness (Stock *et al.* 2000). Indeed, growing competition has motivated manufacturing companies to not only expand their internal operations but also focus on integrating their suppliers into the whole value chain practice (Prajogo *et al.* 2015). Port logistics with the antiquity of thousands of years has developed along with other forms of modern international trade. It handles around 90 percent of the world's merchandise trade comprised of 40 percent dry bulks, 38 percent liquid bulks, 14 percent containers and 8 percent general cargo. This percentage and the volume commodities trade have both been evolving over the last century (Mangan *et al.* 2008; Jacobs 2012; Lam & Zhang 2014). Globalisation has allowed producers to relocate their production and assembly plants to more cost-efficient locations in developing economies, in turn generating a new spatial division of labour and increasing the demand for ocean transport (Massey 1995). From the supply chain perspective, the role of ports can be defined as part of a group of entities in which different transport and logistics operators are involved in bringing value to the final consumers. Ports have become a linking point in larger logistics chains in global distribution channels. Therefore, a higher level of collaboration and coordination is needed for these distribution channels to be successful (Junior *et al.* 2003). The conjunction of logistics and port transport may be mostly attributed to the physical integration of modes of transport facilitated by containerisation and the evolving demands of end-customers that require the application of logistics practices. At the centre of port logistics is the concept of integration, be it physical (intermodal), economic/strategic (vertical integration, governance structure) or organisational (relational, people and process integration across the organisation) (Panayides 2006). The subsequent sections of this chapter explain each aspect in detail.

This chapter reviews the literature on logistics/supply chain integration in the general context and in the port sector. Various databases were used to search for relevant studies on the topic including those published by widely known publishers such as Taylor and Francis, Elsevier, Emerald, Scopus, Thompson Reuters, Google scholar and endnote search engine (Web of Science). Most of the selected articles were published in highly relevant journals including Journal of Operations Management, the International Journal of Logistics Management, Journal of Business Logistics, International Journal of Physical Distribution & Logistics Management, Supply Chain Management: An International Journal, Maritime Policy & Management, Journal of Transport Economics and Policy, Transportation Journal, Asian Journal of Shipping and Logistics. Selection criteria were determined to decide to include or exclude the papers. A large number of articles were excluded after reading the title. The other criteria determined to exclude papers began with the source of publication, then the type of study, then reading the abstract, main focus, study design, implications, publish date and finally reading the full text of the paper. Selected papers were divided into three main subjects as mentioned before. Based on this, the literature review is structured into two main parts: logistics integration as a general concept without any focus on aspecialised industry, and port logistics integration, of which the review is limited to studies on seaports.

## 2.2. VARIOUS FORMS OF INTEGRATION IN BUSINESS MANAGEMENT

In order to explain and justify the research subject, the review starts with the definitions of integration in business management before explaining their application to supply chain/ logistics (Armoon 2013).

Integration, according to Oxford Dictionary, is “to combine two things in such a way that they become a single substance” (Pearsall & Hanks 1998). On the other hand, business integration is a strategy with the aim of coordinating information technology (IT) and business cultures and objectives and aligning technology with business strategy and goals (Rouse & Torode 2012). Integration is also referred to as “the quality of the state of collaboration that exists among departments that are required to achieve unity of efforts by the demands of the environment” (Bagchi, Prabhir K & Skjoett-Larsen 2003). Based on these descriptions, it is clear that knowing how to integrate and what to integrate (at least two things or subjects) is needed to effectively define the integration. In the case of this study, which is about port logistics integration, integration requires the cooperation and efforts of different partners in logistics systems. There are different approaches to integration such as systems integration (Almotairi 2012), organisational integration (inter and intra organisational integration) (Berente, Vandenbosch & Aubert 2009), institutional support (Cai, Jun &

Yang 2010), resource integration (Alfalla-Luque, Rafaela, Medina-Lopez & Dey 2013), cross-functional integration (Foerstl *et al*. 2013), forward and backward integration (Spiegel 2013) which are related to logistics chain integration from operational perspective. Based on Pinmanee (2016) organisational integration, institutional support and resource integration are part of logistics integration activities. There is couple of other types of integration such as virtual integration (Wang, Tai & Wei 2006), technical and social integration (Armoon 2013), horizontal and vertical integration (Martino 2016) and integration frameworks in army industries (Mirabbasi 2012), which is not directly related to scope of this research and based on focus of the research the study will focus on items which are directly linked to logistics/supply chain integration.

### 2.2.1. System integration

The first integrated system goes back to World War II. During World War II, scientists conduct research activities and solve complex physical and organisational problems in order to develop a structured methodology that is now known as System Integration. Linking the subsystems of a larger system is one of the several requirements to achieve an integrated system. It is necessary to control each sub-system in order to achieve the objectives of the original system (Mejabi 1994). System integration encompasses the entire organisational process, administrative works, organisational transactions, structural alliances and knowledge management (Mirabbasi 2012). Almotairi (2012) applied systems integration approach in logistics integration platform in the port context to increase system optimisation and logistics chain visibility for the whole system. Unlike Wilkinson and Dale (1999)'s pioneer study, Almotairi (2012) used three factors to explain the systems approach. These factors have not been used before in system integration studies. The results of the study indicate that the network structure, business processes, management components are important factors. A network structure is about organising different players in the supply chain and managing their relationships. A business process focuses on inbound/outbound logistics and terminal operations and management components concern management of all systems business functions and organisational processes involved in the port sector.

### 2.2.2. Functional integration

Functional integration has a close relationship with organisational integration. In order to achieve high levels of organisational performance, the determinate business strategy needs unique structural forms or circumstances necessitating certain infrastructure projects. Cross-functional integration between different departments shows an important aspect of organisational structure in the field of cooperation between various functions (O'Leary-Kelly & Flores 2002). Research supports the idea that there is a relationship between functional integration and organisational performance. This relationship can be controlled by strategy as well as the organisational environment. For instance, some researchers believe that interaction between levels of integration and business strategy has a direct and positive effect on its performance. Foerstl *et al.* (2013) worked on the idea of cross-functional integration and functional coordination and their effects on firms and purchasing performance. They defined cross-functional integration as a collaboration of product development, production and manufacturing, purchasing and supply management and other related functions related to performance concepts. Gomes *et al.* (2003) proposed a number of items to measure functional integration in the three most important areas of interpersonal relations, communication and task orientation. Therefore, mentioned studies indicate that how different functions, organisations and interpersonal relations can work together to create an integrated unity.

### 2.2.3. Forward and backward integration

Forward integration is a business strategy that includes a type of vertical integration whereby actions are extended to include control of the direct distribution of its products. Forward integration is about acquiring or increasing control over distributors (Spiegel 2013). According to Porter (1985) this type of integration is useful if the following conditions are met:

- Distributors are not reliable and impose a significant amount of cost to the organisation or unable to supply orders;
- The market is predicted to grow dramatically;
- Stability is very important.

Backward integration refers to a company buying or internally producing parts of its supply chain. In other words, backward integration is an acquisition that aims to increase control over suppliers. The following conditions should be met for backward integration:

- Vendors are not reliable and impose a significant amount of cost to the organisation or unable to supply orders;
- Few suppliers with a large number of demanding companies;
- High growth market;
- price stability is important;
- Manufacturing enterprises have a high-profit margin (Porter 1985).

As discussed in different types of integration concept, there are different approaches to integration in supply chain and logistics context. Systems integration is about to integrate the logistics system through systems approach considering inputs (infrastructures), processes (integration procedures and guideline) and output (integrated logistics system). Organisation integration focuses on partners and strategic partnership between actors rather than focusing on activities. Functional integration more focus is on functions and activities in logistics system such as information and operations. Forward and backwards integration focus is mostly on the relationship between suppliers and customers and mostly it uses to investigate manufacturing systems in which the focal firm locate in the centre which facilitates the relationships between upstream and downstream level. The current study will consider the mentioned models and the focus would be on organisational integration and institutional activities which have rarely been studied in logistics integration frameworks (Tseng & Liao 2015). In the following sub-sections, different views of integration in various subjects, which is related to logistics and supply chains, will be reviewed. Although the mentioned integration models have overlap with each other and some of them will cover the other ideas and perspectives, it could have shed the lights on missing parts and give a big picture of what has been done in integration concept to use those experiences in an area which is port logistics integration.

## 2.3. Logistics integration

Logistics management refers to the planning, implementing and controlling of the forward and reverse flow and storage of merchandises, related information and services between the point of origin and the point of consumption, to build efficient and profitable processes to meet customer needs (CSCMP 2016). It is also one of the important parts of a supply chain (Pinmanee 2016). Logistics and supply chain are two similar subjects, which are mostly used interchangeably in the literature. However, two studies notably shed light on the differences between the concepts and clarify each one's role. The first one is about the difference between definitions of logistics and supply chain management, in which supply chain management encompasses logistical flows, customer order management, production processes and the information flows and all the activities within supply chain nodes (Lummus *et al.* 2001). In the second study by Tseng *et al.* (2005a), logistics is introduced as a part of the supply chain process which comprises three stages: inbound logistics (handling the materials received from suppliers), material management (movement of materials within the firm) and physical distribution (transition of goods from final line in company to the customers).

A typical logistics system comprises three main operations: logistics services, information systems and resources or infrastructures. As shown in Figure 2.1, logistics services include the physical handling and process of goods and play a central role in the logistics system. Product and material movement from suppliers to customers as well as reverse flows and waste disposal are important activities in logistics services in both physical (storage and transport) and non-physical (supply chain design and selection of contractors) forms. Information systems denote the management and modelling of designs in the organisation. It provides choices and essential information in order to lead the logistics service to the target stations (Tseng *et al.* 2005b).

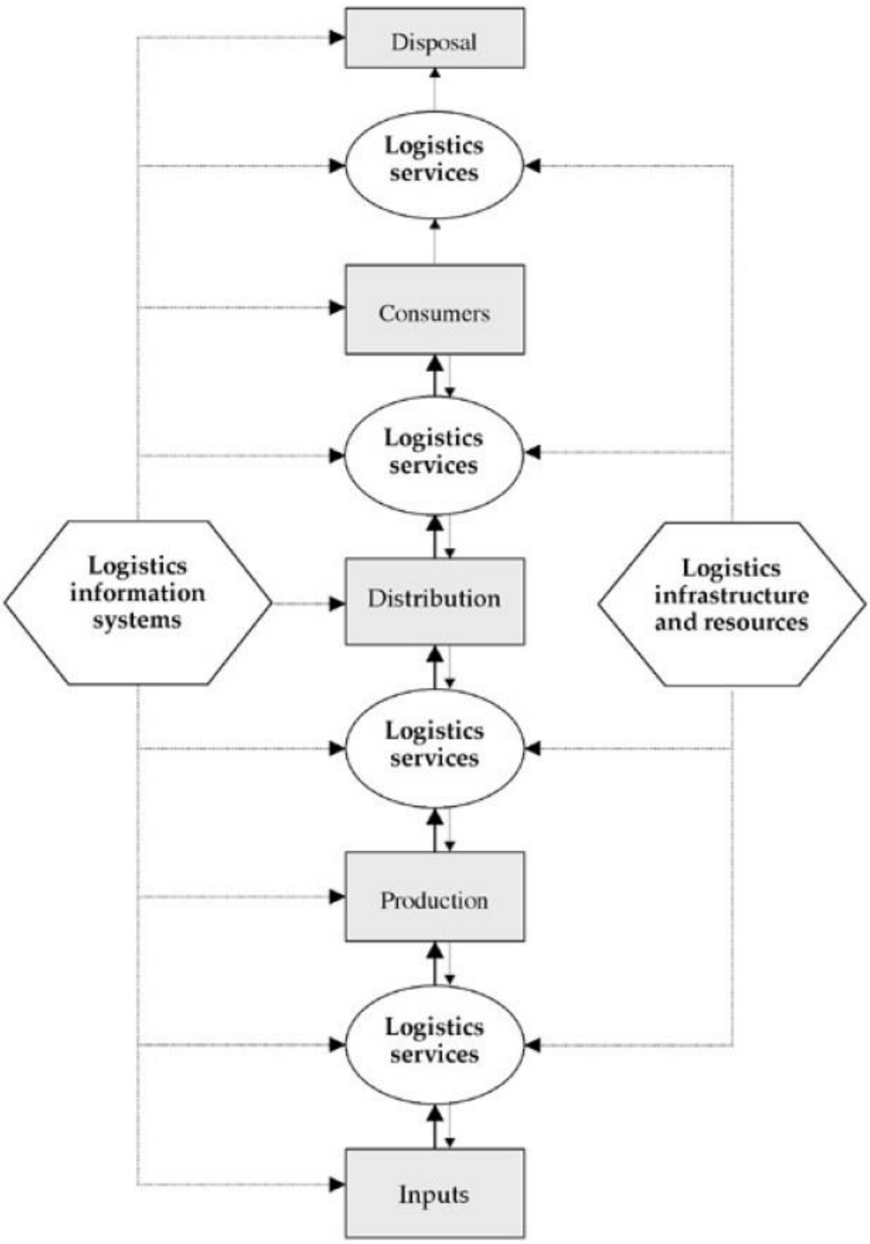


Figure 2.1. Logistic system flowchart
(Source: Tseng *et al.* (2005a))

Because of its contribution to operational efficiency, logistics has developed from a more inactive and cost minimisation oriented activity to a critical success factor for firm competitiveness. It has become an essential part of a firm's strategic planning process in recent years (Carter *et al.* 1997). The fact that companies should attend to customers' needs requires close coordination with customers. Efficient logistics management requires close communication with manufacturing and marketing to plan, coordinate and integrate the activities between them in an efficient way.

Based on the definitions of logistics, the logistics system encompasses three main parts which should be integrated with each other. The first two are about information and physical (material) flow and the third stream is infrastructure and resources, which have a supportive role. According to Tseng *et al.* (2005a), logistics services include physical activities (e.g. transport, storage) as well as non-physical activities (e.g. supply chain design, selection of contractors, freightage negotiations) to manage the relationships between three flows to obtain an integrated logistics system. Therefore, efficient supply chain and logistics operations often mean seamlessness operations and the relationship between partners. Moreover, inefficient supply chain and logistics operations could be due to a mismatch between the capabilities of freight and logistics providers and distributors and logistics integration offer a solution to fix and integrate inefficient activities and functions among partners.

According to Caputo and Mininno (1996) logistics integration can take place into three areas, namely within each business (internal integration), between the same level of channel in different businesses (horizontal integration) and between business at different stages of the chain (vertical integration), in order to identify organisational and managerial solutions to improve cross-functional and inter-organisational coordination. Internal integration and horizontal integration are prerequisites of vertical integration to have a significant synergy for institutions that run it.

*Internal logistics integration:* Internal logistics activities usually refer to integration across functional boundaries within a firm (Paulraj & Chen 2007) and it is the first step toward the whole supply chain integration (Furlan *et al.* 2011). As a result, logistics organisations are normally distribution driven companies. In large-scale commercial deals, there is usually a manager for logistics activities, but his position and his functions often vary in different industries.

*Vertical logistics integration:* Vertical integration is a function of order management between institutions at different levels of the channel. Closer integration between physical flow and information flows between producers and distributors improve the level of services and the average store inventory (Naik *et al.* 2010).

*Horizontal logistics integration*: Horizontal logistics integration is about coordination between institutions is based on a similar level of the distribution channel. This definition suggests that greater cooperation between producers and distributors is essential for improving vertical integration and global performance in a channel. A large number of solutions for integration can be conducted simply through one-by-one collaboration, which is close to horizontal cooperation because of the transition to vertical integration solutions generated by many-to-many relationships (Caputo & Mininno 1996).

*Enterprise logistics integration:* A recent trend in global manufacturing has increased supply chain complexity. It has also strengthened the concept that strategies and logistics activities are essential factors in business. Logistics complexity has increased through the movement of organisations from focused production facilities and vertical integration to geographically dispersed networks, which create value for customers. Traditional logistics activities and production activities in technologies are integrated into the factory as necessary but are not sufficient for competitive success. Logistics activities and new technologies should have interconnected production processes and logistics in various organisations across geographically dispersed locations (Stock *et al.* 2000).

Based on Bowersox *et al.* (1999) supply/ logistics chain integration is about fully integrated processes of logistics which lead to value creation. They include six crucial areas of competence: customer, material/ service supplier, internal competence, technology and planning, measurement and relationship integration (Stank, Keller & Closs 2001). In a recent study by Pinmanee (2016) in the Thai egg industry, logistics integration was defined as having the four main factors of information integration, operations coordination, organisational relationship and institutional support. In addition to mentioned functions and activities, an integrated logistics system needs to focus on improving the level of customer service, the competition ability of the firm in the logistics chain and update the current technologies and functions (Wei 2017). Besides, the study by Zhu, Qiu, *et al.* (2018) highlights the impacts of integrating and sharing the resources in logistics integration. The study implies that implementing interconnection and interworking among objects is a need for an integrated logistics system.

### 2.3.1. Supply chain versus logistics integration

In this section, the difference between these two concepts will be discussed, and the reasons for this study's focus on logistics integration rather than supply chain integration will also be explained. Supply chain and logistics integration concepts have many interconnections. It is worth noting that many studies did not differentiate between these concepts as shown in Fabbe-Costes and Jahre (2008a), Spillan, McGinnis, Kara and Yi (2013) and Mellat-Parast and Spillan (2014b).

Supply chain integration is defined as the degree to which the focal firm strategically collaborates with its key supply chain partners to coordinate the traditional business functions (e.g. production, marketing and sales, purchasing, logistics, R&D and finance) to create maximum value to the customer (Mentzer *et al.* 2001; Flynn *et al.* 2010b; Zhu, Krikke, *et al.* 2018). In this definition, it is clear that supply chain contains a wide variety of activities, which logistics is one part with a focus on transportation, storage and distribution (Rezaei *et al.* 2015).

Palomero and Chalmeta (2014) define SCI from SME's point of view as "a continuous improvement process of interactions and collaborations among supply chain network members to improve their ability to work together to reach mutually acceptable outcomes for their organisation". Wong, Boon-itt, *et al.* (2011) describe the supply chain as a strategic collaboration between both intra- and inter-organisational processes. This definition describes supply chain integration from an operational perspective. Zhao *et al.* (2011) described supply chain integration as being similar to previous research, with the only difference being about the organisational point of view which was an operational/industrial view in his previous one. Chen *et al.* (2009b) referred to supply chain integration as "The management of various sets of activities that aim at seamlessly linking relevant business processes within and across firms and eliminating duplicate or unnecessary parts of the processes for the purpose of building a better-functioning supply chain". These definitions stress that supply chain integration is linked to a close relationship, which works with the different parties as a single entity. In most papers, logistics/ supply chain integration is used instead of each other or at the same time (Gimenez 2006; Fabbe-Costes & Jahre 2008b), and they do not separate these two terms from each other. In the next paragraph, some differences between these two terms are mentioned. Integration is considered the main characteristic (Hong *et al.* 2012), and a performance-improving task of supply chain management (Van Donk *et al.* 2008) Alfalla-Luque, Rafaela, Medina-Lopez and Dey (2013) reviewed the supply chain integration literature between 1995 to 2009 and proposed three dominant factors including information integration, coordination and resource sharing and organisational relationship linkage. Supplier integration was mentioned in almost all research papers in this area and customer integration was referred to in more than 80 percent of the studies. Nearly half of the studies used an internal and external integration approach. To sum up, information integration, coordination and resource sharing and organisational relationship linkage are the key components of supply chain integration.

Table 2.1 presents the key factors in supply chain integration suggested by various studies. Comprehensive collaboration among supply chain network members in strategic, operational and tactical decision-making activities can ensure the success of those activities (Bagchi *et al.* 2005). According to Table 2.1, supply chain integration can be defined as a mechanism, which supports business processes across the supply network when successfully applied in each context. It is also closely connected to activities for overcoming intra- and inter-organisational boundaries (Romano 2003).

Table 2.1. Key components of supply chain integration

| Source | Supply chain integration components |
|---|---|
| **Alfalla-Luque, Medina-Lopez and Dey (2013)** | (i) External integration (between supplier and customer) and internal (within the entities belonging to the organisation) integration, (ii) process integration, and (iii) information/data and physical/material flow integration |
| **Vickery *et al.* (2003)** | customer (or downstream), supplier (or upstream), horizontal (associated with all processes within the supply chain) integration. |
| **Wong, Boon-itt, *et al.* (2011)** | strategic collaboration of both intra- and inter-organisational processes |
| **Fabbe-Costes and Jahre (2008b)** | (i) integration of flows (physical, information and financial);<br>(ii) integration of processes and activities;<br>(iii) integration of technologies and systems; and<br>(iv) integration of actors (structure and organisations). |
| **Bowersox *et al.* (1999)** | (i) customer integration, (ii) internal integration, (iii) material/service supplier integration, (iv) technology and |

| | |
|---|---|
| | planning integration, (v) measurement integration, and (vi) relationship integration. |
| **Hong *et al.* (2012)** | The upstream and downstream product, service, financial and information flows, through an extended network of the supplier's key suppliers and the customer's key customers. |
| **Flynn *et al.* (2010b)** | intra- and inter-organisational process collaboration. internal integration, external integration (customers and suppliers) |
| **Kim (2009)** | all material and product flow within the supply chain, commencing with vendors and ending with delivery to the final consumers through a broad range of different organisational entities, as well as external (suppliers) and internal (functions) processes. |

As the focus of this research is on the port sector, especially port operation and management, and it is well known that ports are nodes in a multimodal transport and logistics system (Drewe & Janssen 1998; Mangan *et al.* 2008). Therefore the logistics integration concept would be more relevant than the supply chain integration concept. Although some developed ports include production activities, agility and research and development which are related to supply chain integration, it is better to consider ports as part of a logistics system rather than a supply chain (Paixão & Bernard Marlow 2003)

Logistics integration can be defined as the integration of logistics activities in the functional departments of the firm as well as other supply chain members (Pinmanee 2016). According to Stock *et al.* (2000) logistics integration is related to operational and logistics practices which organise flow of materials from upstream to downstream in a value chain while supply chain integration is related to different kinds of activities in the value chain such as performance measurement, product development, procurement and manufacturing, customer service, information sharing and logistics. On the other hand, supply chain integration refers to manufacturing and procurement subjects which include suppliers, manufacturers and retailers in a broader sense, whereas logistics integration refers to product distribution within organisations. Therefore, this study will focus on logistics integration, which is mostly about handling, and the distribution of goods. However, it is not possible to separate in terms of logistics integration and supply chain integration.

The concept of logistics integration of material flow between supply chain partners has mostly been absent from empirical studies (Prajogo *et al.* 2015). By looking at the supply chain/logistics integration literature, researchers have been able to define it from different perspectives, such Kwon and Suh (2005), who explained it as “a strategic tool, which attempts to minimise the operating costs and thereby enhancing values for the stakeholders (customers and shareholders) by linking all participating players throughout the system, from supplier’s suppliers to the customers” (Kwon & Suh 2005). Based on Rajaguru and Matanda (2009) the concept of logistics integration is integrating a firm’s activities so as to reduce the logistic costs to customer’s needs. To simplify the definitions, logistics integration needs coordination mechanisms to manage logistics process effectively (Zhang & Kang 2010). Boon-itt and Wong (2011) also describe supply chain integration, as a strategic collaboration of both intra- and inter-organisational processes. Stock *et al.* (2000) defined logistic integration as definite logistics practices and operational activities that organise the flow of materials from suppliers to customers throughout the value stream. The literature provides numerous performance benefits for supply chain integration such as higher returns on investment, higher returns on assets, lower costs, a higher quality of products and services, higher level of customer service, and effective knowledge management mechanisms (Mellat-Parast & Spillan 2014b).

### 2.3.2. Application of logistics integration

The application of the logistics integration concept can be divided into two main periods. Pre-2000, logistics integration was mainly considered from a strategic perspective and there were only a few studies on operational parts. Post-2000, more focus was given to the operational aspect of ports. In recent years, the role of partnership and cooperation in logistics integration has also been considered.

Bowersox and Daugherty (1987) proposed one of the first ideas in logistical organisation integration and suggested that process, market and information dimensions are important factors in this area. Beal (1988) showed that competitive logistics strategy, strategic process development and the integration of information are the main factors in implementing this concept. Kohn and McGinnis (1997) identified logistics coordination effectiveness, competitive responsiveness and customer service effectiveness as strategies and key factors of logistics integration. McGinnis and Kohn (1993) added further two other dimensions to this logistics integration strategy, including organisational environment and time competitiveness. The authors then used previous studies in addition to Bowersox and Daugherty (1987) and the results showed that effective logistics coordination, customer service commitment and competitive responsiveness were the three main factors which affect process integration and the level of integration (Kohn & McGinnis 1997).

Stock *et al.* (2000) added the concept of enterprise logistics to the literature review based on the work done by Greis and Kasarda (1997) and as a tool to integrate logistic activities (internal and external al integration) between and within strategically oriented firms. Based on their study it has been understood that there are four areas such as functional logistics, integrated logistics, inter-firm logistics, and enterprise logistics, which is a combination of internal and external logistics activities in organisations. This is an internal-external approach to logistics integration with the internal approach referring to higher levels of internal integration, which would include increased coordination of logistics activities with other departments in the firm, as well as increased communication. External integration relates to the integration of logistics activities across a firm's boundaries and to the extent to which the logistics activities of a firm are integrated into the logistics activities of its suppliers and customers. Results indicate that enterprise logistics are crucial for the coordination of supply chains, which have spread around the world.

Based on the literature on logistics integration before 2010, strategy and information were large-affected factors to logistics integration. For instance, Boer (1992) studied the information integration factor in the logistics operations context. He examined how aggregated and detailed feedback can help organisations to enhance their performance. Logistics information systems capabilities are proposed as a new approach to logistics integration by Closs *et al.* (1997) to increase logistics competence. Closs and Savitskie (2003) investigated logistics information technology (both internal and external) and customer integration as variables of logistic integration in customer service performance. Häkkinen *et al.* (2004) studied logistics integration after mergers and acquisitions of firms especially strategies can be implemented by firms to keep synergy and effectiveness in the firm. Rodrigues *et al.* (2004) found logistic integration in linking strategy, structure, process, and performance based on an empirical study. The important point was the comparative strength of relationships between internal integration and performance and external integration and performance. They infer that the achievement of superior logistics performance involves the simultaneous integration of internal and external operational processes. Another study has been done to investigate information technologies and logistics strategies within the retail logistics function (Bourlakis & Bourlakis 2006). Fabbe-Costes and Jahre (2008a) proposed a new approach to the supply chain and logistics literature. They investigated the role of logistics service providers in supply chain integration and performance. Moreover, they proposed the role of actors' integration in supply chain integration studies, which will be explained in detail below. They argued that logistics/ supply chain integration can be regarded as the combination of the following key components:

- Integration of flows (physical, information and financial),
- Integration of processes and activities,
- Integration of technologies and systems,
- Integration of actors

The findings indicated that dominant approaches approved the relationship between logistics integration and performance.

Uusipaavalniemi and Juga (2008) regard information integration as one of the most important factors of logistics integration in the context of service supply chains. Six factors were proposed to evaluate the level of integration. Han *et al.* (2008) analysed the effect of information integration, logistics management and quality management on company performance. The results showed that information integration and logistics management influence firm performance through quality management activities.

One of the pioneer studies to considering operational parts of logistics integration was the study by Mortensen and Lemoine (2008) in which third-party logistics providers integration and manufacturers have been studied in this research. Integrating third-party logistics providers depends on what communication tools are used for support and what types of services are expected to be supplied. McGinnis *et al.* (2010) identified six factors influential to logistics strategies for the period 1990-2008 including process strategy, marketing strategy, information strategy, logistics coordination effectiveness, customer service commitment and company competitive responsiveness were chosen as effective for this area.

Narayanan *et al.* (2011) investigated process integration roles in business process outsourcing. They divided process integration into internal and external sections and finally concluded that process integration can lead to firm performance. Bennett and Klug (2012) looked at logistics integration as a supplier point of view, which has rarely been studied in recent papers. They found five conditions that explain supplier integration in the automotive industry. Among those factors, geographical proximity was the most suitable factor in a special context. Elkhouly and Hamdy (2012) proposed a framework to integrate small firms with large firms in which agile and lean logistics and organisational integration should be considered together. Chinomona (2014) investigated the relationship between strategic purchasing and information technology in logistics integration and its impact on the performance of SMEs. He defined logistics integration as an important factor in supply chain management and stated that it could have a positive impact on operational cost reduction, bring improvements in customer services, improve financial and organisational performance, improved business performance and enable the potential for contingency in the decision-making process (Moshkdanian & Molahosseini 2013). To measure logistics integration the factors considered by Prajogo and Olhager (2011) are also used in this study. The results showed a positive relationship between IT, Strategic purchasing logistics integration and the performance of SMEs. Spillan, McGinnis, Kara and Yi (2013) used Bowersox and Daugherty (1987) factors to measure logistic strategies in a comparison between two countries. Results revealed that process, market and information strategy worked well in both countries to achieve firm competitiveness. Wong *et al.* (2015) brought environmental management into it and attempted to develop a new concept called “Green Supply Chain Integration”. This study identified the internal, supplier, customer and stakeholder as green supply chain integration measures. Based on this researcher’s work, the most common factors will now be explained in detail.

## 2.4. KEY AREAS IN LOGISTICS INTEGRATION

Table 2.2 summarises the three main approaches to logistics integration as identified in the literature. The first approach divides the logistics activities into two types; the first is internal to the firm (internal) and the second is between the firm and its logistics chain partners (external). This approach favours a more strategic and organisational view of logistics integration activities (Flynn *et al.* 2010a). The second approach is the integration between logistics partners in the logistics chain which is called the actor's (partner) integration approach. The current study aims to take this approach and adopt different actors' views on logistics integration. The third considers the role of organisational, institutional and resource integration as influential factors in logistics integration, in addition to traditional logistics functions such as information and process integration. However, these streams have many interconnections with each other, as will be discussed in detail later in this chapter. The next sub-sections explain these approaches in detail.

Table 2.2 Approaches and dimensions in logistics integration

| Approaches | Dimensions | Sources | Components |
|---|---|---|---|
| **Internal-external approach** | Internal-external integration | (Stock *et al.* 2000) (Pinmanee 2016) (Rodrigues *et al.* 2004; Narayanan *et al.* 2011) (Gimenez 2006) (Zhao *et al.* 2011) (Chen *et al.* 2009a) (Gimenez & Ventura 2005) (Wong *et al.* 2013) (Wong, Lai, *et al.* 2011) (Vargas *et al.* 2000) (Sundram *et al.* 2015) (Sundram *et al.* 2015) (Prajogo *et al.* 2018) | Coordination of logistics activities, increased communication, formal distinction, inbound distributional activities, internal logistics production (informal teamwork, shared ideas, joint planning, the establishment of objectives, responsibility understanding, cost efficiency improvements) |
| | Internal integration | (Springinklee & Wallenburg 2012) (Lai *et al.* 2008) (Caputo & Mininno 1996) (Chavez *et al.* 2015) (Dassisti *et al.* 2012) (Lee *et al.* 2007) (Tian 2009) (Williams *et al.* 2013) (Zsidisin *et al.* 2015) (Springinklee & Wallenburg 2012) (Lai, Wong & Cheng 2008) (Caputo & Mininno 1996) (Chavez *et al.* 2015) (Dassisti *et al.* 2012) (Lee, Kwon & Severance | Achieved integration (on time, seamless, personnel integration), outbound distribution activities, horizontal integration, inter departmental integration or intra-firm integration |

| | | | |
|---|---|---|---|
| | | 2007) (Tian 2009) (Williams *et al*. 2013) (Zsidisin *et al*. 2015) | |
| | External integration | (Lai *et al.* 2008) (Quesada, Rachamadugu, Gonzalez & Martinez 2008) (Barreau 2002) (Tan *et al.* 2017) | Inter-organisational integration, vertical coordination and integration, customer integration, supplier integration |
| **Actor (Partner) integration** | Actors (partner) integration | (Fabbe-Costes & Jahre 2008b) (Allen *et al.* 2010) (Chen 2014) (Mentzer *et al.* 2000) (Rezaei *et al.* 2015) (Spekman *et al.* 1998) (Williamson *et al.* 2004) (Zhang *et al.* 2006) (Yuen & Thai 2017) | Organisational and strategic partners, multimodal integration, partner integration (buyer, seller, wholesaler, manufacturer, government, private institutes) intermodal transport networks |
| **Functions and activities approach** | Information integration | (Bowersox & Daugherty 1987; Beal 1988; Boer 1992; Closs *et al.* 1997; Kohn & McGinnis 1997; Bhatt 2000; Closs & Savitskie 2003; Bourlakis & Bourlakis 2006; Han *et al.* 2008; Lai *et al.* 2008; Uusipaavalniemi & Juga 2008; Prajogo & Olhager 2011; Bao *et al.* 2012; Prajogo & Olhager 2012; Spillan, McGinnis, Kara & Liu Yi 2013; Alam, K. Bagchi, *et al.* 2014; Mellat-Parast & Spillan 2014a) (Pinmanee 2016) (Lee, Chin Lin, *et al.* 2009) (Fabbe-Costes & Jahre 2008b) (Chinomona 2014) (Bennett & | Processes and activities, information technology use, information attributes, information sharing practices, collaborative foundation, time-related issues, operational information sharing, electronic data interchange (EDI), location information systems |

| | | |
|---|---|---|
| | Klug 2012) (Alfalla-Luque, Medina-Lopez & Dey 2013) (Alam, K. Bagchi, *et al.* 2014) (Han *et al.* 2008) (Gunasekaran & Ngai 2004) (Closs *et al.* 1997) (Cai *et al.* 2010) (Yu *et al.* 2018) | |
| Process (physical) integration | (Bowersox & Daugherty 1987; Beal 1988; Kohn & McGinnis 1997; Romano 2003; Rodrigues *et al.* 2004; Chen *et al.* 2009a; Fredriksson & Johansson 2009; Bourlakis *et al.* 2011; Katunzi 2011; Narayanan *et al.* 2011; Spillan, McGinnis, Kara & Liu Yi 2013; Mellat-Parast & Spillan 2014a; Prajogo *et al.* 2015) (Robertson 2006) (Pinmanee 2016) (Fabbe-Costes & Jahre 2008b) (Chinomona 2014) (Alfalla-Luque, Medina-Lopez & Dey 2013) (Han *et al.* 2008) (Elkhouly & Hamdy 2012) (Quesada, Rachamadugu, Gonzalez & Luis Martinez 2008) | Efficiency in activities, cross-functional work teams, planning and scheduling activities coordinated with strategic planning, level of distribution, transportation and warehousing activities, task cooperation, monitoring and quality control, agile logistics, lean logistics |
| Organisational integration | (Curtis & James 2004) (Wong & Boon-Itt 2008) (Bastian & Zentes 2013) (Cai *et al.* 2010) (Laeequddin 2009) (Han *et al.* 2013) (Tadeu Simon *et al.* 2014) (Codron *et al.* 2014) (Sindi & Roe 2017) | Trust and commitment, cross-functional teams, share risks, costs and rewards, maintaining long-term relationships |

| | | | |
|---|---|---|---|
| | Institutional support | (Monios 2016) (Yangınlar & Kalaycı 2017) (Kauppi 2013), (Sumantri & Lau 2011), (Chen & Cai 2011), (Habib 2014), (Tadeu Simon *et al.* 2014), (Codron *et al.* 2014) | Public safety regulations, Legal requirements, Sharing of skills and ideas, government policy |
| | Resource sharing | (Zhang & Li 2017) (Beinke *et al.* 2017) (Alfalla-Luque, Medina-Lopez & Dey 2013) (Xu *et al.* 2014) (Adams *et al.* 2014) (Karia & Wong 2013) (Yao & Liu 2007) (Quesada, Rachamadugu, Gonzalez & Luis Martinez 2008) (Yao 2015) (Yao 2010) (Van Donk & Van der Vaart 2005) (Huo *et al.* 2015) | Share containers, involving human resources in decision making, organising a balanced workload between parties |

### 2.4.1. Internal-external logistics integration

As shown in Table 2.2, logistics integration can be divided into two types; "internal integration" refers to "integration of logistics activities with activities in other functional units of a given firm such as production and marketing"; and "external integration" is "integration of a firm's logistics activities with other partners in the supply chain" (Stock *et al.* 2000; Lai *et al.* 2008; Gimenez *et al.* 2012; Bosona 2013). Chen *et al.* (2009a) also conceptualised internal and external supply-chain management.

Internal integration is defined as "the quality of the state of collaboration that exists among departments that are required to achieve unity of effort by the demands of the environment" (Chen *et al.* 2009a). In another point of view, it is defined as the extent to which functional units (like Warehouse, inventory, transportation, Packaging and material handling) have an interconnection between each other. Internal integration is expected to facilitate external process integration. In Gimenez and Ventura (2005) internal activities of the firm include three sections: marketing, production and logistics. Before existing of today's logistic concept, activities like production and marketing were known as independent departments. However, after highlighting the role of logistics, marketing and production are considered as subdivisions of logistics.

External integration in logistics is defined as "integration of a firm's logistics activities with other partners in the supply chain" (Bosona 2013). According to Stock *et al.* (2000), most of the firms determined networks (such as "electronic data interchange") to be in contact with different departments which can facilitate their relationship with customers and suppliers in an integrated network. In other words, the level of communication between supply chain members will determine its successfulness (Narayanan *et al.* 2011). External integration can be improved by informal teamwork with partners, the level of information sharing in sales forecast, inventory level and level of actual sale, Joint sessions with partners to resolve operation problems, determined goals and objectives, decide about reducing the costs and set the responsibilities (Gimenez & Ventura 2005). Gimenez (2006) proposed another model for internal-external integration perspective. Internal integration is considered in two interfaces: Logistics marketing, logistics production, and external integration. Prajogo *et al.* (2015) research on the relationship between supply logistics integration, supply performance, lean process and competitive advantage is one of the latest studies, which consider logistics integration in internal and external activities. They defined transportation and inter-organisational activities, distribution and warehousing facilities as internal factors and relationship and integration with suppliers as external activities of a firm.

### 2.4.2. Information integration

The literature on logistics integration shows that information integration is the most agreeable factor in logistics integration in both pre- and post-2000 studies. It can be defined as "the set of practices (such as electronic data interchange or integrated computer systems) associated with design and development of information systems across logistics and supply chain" (Mellat-Parast & Spillan 2014a, p. 293).

Sadler (2007, p. 125) defined integrated logistics information systems as "the involvement of people, equipment and procedures required to gather, sort, analyse, evaluate and then distribute needed information to the appropriate decision-makers in a timely and accurate manner so they can make quality logistics decisions". In Uusipaavalniemi and Juga (2008), six important aspects of information integration were mentioned and examined in the service industry including information attributes, information sharing practices, information technology use, collaboration foundation, time-related issues, processes and activities. Information technology in an organisation can reduce the bullwhip effect and allow information sharing to occur in a more accurate way between partners through the supply chain (Lee, Svensson, *et al.* 2009; Raghu & Brat 2012). According to Bloomberg *et al.* (2005), the essence of information sharing /systems is to transfer data to valuable information. Lack of suitable information can disrupt logistic activities (transportation, customer service, production, warehouse operations and inventory management). The main purpose of information systems is providing concise and on time information to respond to today's challenging markets (Bhatt 2000).

#### 2.4.2.1. Information flow and functions

Many logistics experts believe that the application and integration of information technologies is one of the most important aspects of logistics operations management. Inventory requirements, customer orders, warehouse work orders and transportation documents are the common types of logistics information, which help the system to be more efficient and effective (Tian 2009; Sharkey 2011).

A typical logistics information system forms the relationship between logistics activities and logistics processes and has the following functions:

- Enhance the efficiency of the system, improve the information transaction process in the organisation and between supply chain partners and simplify the information management process
- Make the biggest input-output ratio in use of human resource and materials
- Increase the system speed so that they can deliver the goods and services in the quickest possible time to the customers
- Gain appropriate and up to date information from suppliers, customers and partners in order to make suitable decisions (Tian 2009; Sharkey 2011)

#### 2.4.2.2. Information integration components

The previous section generally explained what information integration is and how it effects on logistics system to be integrated. This section will have a look at the key components of information integration. According to Han *et al.* (2008), there are two types of information integration; forward integration is one in which the direction of information is from suppliers to customers and third-party logistics play an important role, and backward integration is one where the flow of information is from customer to supplier. In Prajogo and Olhager (2011) information integration in the supply chain has two aspects: technical aspects which are related to the communications (IT) part of it and social aspects like information sharing.

Information technology can improve the efficiency of the system through. Its ability to intensify the capacity and the complexity of data. It is important to develop agile and real-time systems and it can speed up the furcating and planning of ordering goods and materials in organisations. Besides the technical side of it, information sharing can also help with information integration. Suitable structure (Croom *et al.* 2007) and high levels of trust (Seidmann & Sundararajan 1997) are the most important factors in information sharing. Information integration has been discussed comprehensively in research done by Barzi (2009) in which two important aspects of information integration have been mentioned: information sharing and information integration tools.

**Information sharing**

Information sharing is knowledge transfer behaviour in the process of an organisational outside and inside a relationship and it is the knowledge that a person gains in an organisation (Lin *et al.* 2009). The impact of information sharing on an organisation and its partners have been investigated from different perspectives. Information sharing can reduce organisational costs and the formation of the business model (Trkman *et al.* 2007). Based on Mentzer *et al.* (2000) information sharing is one of the crucial parts of creation, communication and the collection of information which leads to the effectiveness, efficiency and competitive advantage of every supply chain. In the point of view of Simatupang *et al*. (2002), the flow of information in the supply chain increases clarity between supply chain members. He mentioned different sources of information in supply chains, which include resource availability (like capacity and inventory), process information (like forecasting, ordering, delivery), performance status (like time, quality and cost) and other forms of information. Barzi (2009) believes that the role of information sharing can be divided into two aspects, communication and willingness. In his research, an interview method was used to analyse relationships by a two-by-two matrix, and the results showed that this had important impacts on the sharing of information in a supply chain. Other results of information sharing would be cost saving and inventory reduction for suppliers, and if information sharing combines with replenishment coordination, the cost savings and inventory reduction could be for both suppliers and retailers.

Information sharing is considered the most important part of knowledge management and it is movement in which staff distribute and share useful information with each other for common benefits (Reychav & Te'eni 2009). It can be regarded as voluntary distribution of skills, acquired experience and related knowledge (Bartol & Srivastava 2002). It has become a business management practice (Huysman & Wit 2000) and therefore, identifying, obtaining, sharing and storing knowledge has become a vital task for organisations to achieve competitive advantage (Hsu 2006).

There are four mechanisms for information sharing in organisations:

- Storing information in a database of the organisation and retrieving the existing knowledge at necessary times.

- Sharing information informal interaction among people in teams and business units.
- Sharing information in informal interactions.
- Sharing information in an informal group working, or social channels (Reychav & Te'eni 2009).

Different tools can be used to integrate the information systems between logistics providers such as electronic data interchange. The following sections explain the two main information integration tools (Enterprise Resource Planning and Electronic Data Interchange).

**Enterprise resource planning (ERP)**

ERP is a comprehensive system, which is designed for the development of three different pieces of software, that is, predecessors' application software, Material Resource Planning (MRP) and Manufacturing Resource Planning (MRP II). Beheshti (2006) defines ERP as a "set of business units of an organisation such as financial, accounting, manufacturing and human resource into a tightly integrated single system with a common platform for the flow of information across the entire business". Some studies have investigated the role of ERP in the supply chain and its partners. One important study is related to Akkermans *et al.* (2003), in which the impact of ERP on Supply chain management (SCM) has been discussed. The findings indicated that mass customisation, global IT usage and standardisation are SCM opportunities for ERP. On the other hand, a lack of flexibility in adopting changes, a lack of advanced decision support capabilities is some of the drawbacks that exist for implementing ERP in the context of supply chains.

**Electronic Data Interchange (EDI)**

EDI is defined as "the direct computer to computer communication of intercompany and intracompany business documents in a machine-readable standard format" (Crum *et al.* 1998), cited by (Barzi 2009). In other words, it is a method for the inter-organisational exchange of information which is provided in an automatic way of sharing information between supply chain partners. It can also help firms to have frequent and routine transactions, faster processing speeds, reduced costs, a competitive advantage, revised operations, tracking and control, security and greater accuracy (Lim & Palvia 2001; Barzi 2009).

Based on Bloomberg *et al.* (2005), the process of information integrated systems is divided into four main components: the research and intelligence system, the report and output system, the order processing system, and the decision support system. These factors help managers to make decisions with timely and accurate information. The figure below shows the interaction between logistics manager functions, the information integration process and the logistics managerial environment. In the next stage, the components of the integrated logistics information system will be discussed in detail.

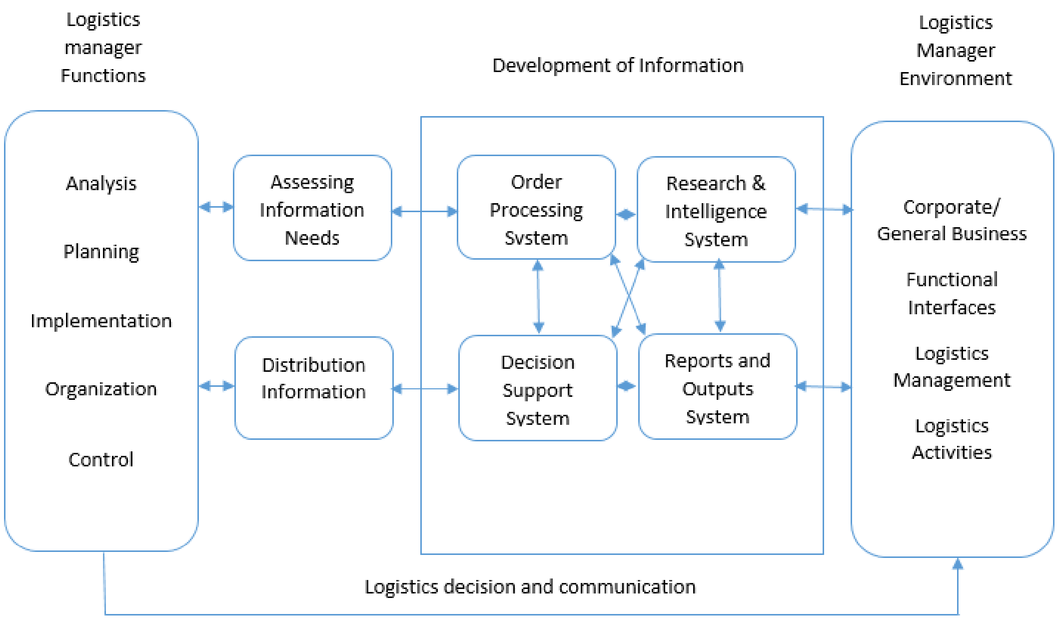


Figure 2.2. The integrated logistics information system
(Source: Bloomberg *et al.* (2005))

*The research and intelligence system*. This system is continuously observing and analysing the environment and events, which affect the firm's logistics operations. Three different aspects of the environment are analysed during this process; intra-firm, inter-firm and external environment. The intra-firm environment includes internal activities in the firm and those items which are under the control of the firm. The inter-firm environment encompasses the activities in the external environment that directly affect the firm. The firm has an acceptable amount of control over those activities, and the external environment includes activities that occur outside of the firm which the firm does not have control over. In this system, some subjects should be controlled for strategic options for the organisation and staffing, the integration of information technologies, the focus on productivity and equality in integrated logistics.

*The decision support system* is a computer-based program, which uses analytical modelling to solve logistics integration problems. There is a comprehensive database in the heart of the system, which helps managers to make decisions. This database includes a basic file data of internal and external information for analytical modelling, a file related to previous problems that can hold solutions for future problems, data files for policy, and parameters to determine policies for logistics integration (Helferich 1983).

*The report and outputs system*. There are four different reports in logistic integration, which include normal reports (used for planning operating and controlling the system), planning outputs (used for sales trends, marketplace information and economic forecasts), operating reports (purchasing, transportation and inventory control) and control reports (for analysing expenses, budgets and performance) (Bloomberg *et al.* 2005).

*The order processing system*. This is listed as the most important subsystem of an integrated logistics information system. Traditional forms of ordering systems were manual, in which handwritten notes and manually filling forms were used. Nowadays, online methods and professional software receive orders automatically and send them directly to third-party manufacturers in other countries. The manufacturer attaches the order sheet to the product and ships the product directly to the customer. Having a professional order processing system creates a win-win situation for both businesses and their customers (Ingram 2015).

### Information quality

Uusipaavalniemi and Juga (2008) proposed that the type of accessibility and its quality are important features of information exchange between supply chain partners. For instance, regarding the form and mode of information, some users prefer printed types of information and others prefer electronic types (Freiden *et al.* 1998). According to Baroudi and Orlikowski (1988), information quality is comprised of four features: reliability, usefulness, accuracy and completeness. Another approach to information quality is proposed by Bloomberg *et al.* (2005) and it encompasses three aspects: getting the right information, information accuracy, and effectively communicating the information.

### 2.4.3. Process Integration

Chen *et al.* (2009a, p. 29) define process integration as “a set of continuous restructuring activities aimed at seamlessly linking relevant business processes and reducing redundant or unnecessary processes within and across firms”, while Bowersox and Daugherty (1987) define it as a set of measurable activities which adds value to the system and has positive customer outcomes (Bowersox & Daugherty 1987; Chen *et al.* 2009a). Stock (2002) note process integration is a key factor in the successfulness of SCM.

Narayanan *et al.* (2011) believe that both internal and external process integration is needed for an integrated organisation. Internal process integration comprises coordination between different processes and activities in an organisation, such as the coordination of logistics planning with overall strategic planning. External process integration refers to the interdependence between the processes of the suppliers, customers and third-party logistics providers which includes: the coordination of logistics activities with other supply chain partners; offering a level of service to customers that fits with the level of development and training in staff; and the coordination of client service plans with firm logistics activities.

Chen *et al.* (2009a) two key drivers of process integration, namely cost orientation and customer orientation. Cost orientation refers to the culture of an organisation to focus on cost reduction (Porter 1985). Chen *et al.* (2009a) propose linking and simplifying processes in the supply chain to reduce transaction and production costs. The long-term and close relationship between partners can reduce monitoring controlling costs and economies of scale in the supply chain. Customer orientation, on the other hand, focuses on customer needs and satisfaction as the priority in their business strategy (Chen *et al.* 2009a). Robertson (2006) investigates process integration, socio variables and supply chain principles relationship with business performance. The author has found a positive relationship between process integration in planning and scheduling activities, e- logistics and transaction activities.

### 2.4.4. Organisational integration

By looking from a strategic perspective to logistics integration, organisational integration activities mostly focus on managing the relationships among supply chain partners (Swink *et al.* 2007; Alfalla-Luque, Medina-Lopez & Dey 2013; Pinmanee

2016). An integrated logistics system needs integrated organisational activities such as incentive realignment, design communication networks, setting performance measures, setting joint objectives with all partners, sharing of skills, ideas, and institutional culture, drawing contingency plans for prompt problem solving, maintaining long-term relationships, extended teamwork and cross-functional activities (Lee *et al.* 2000; Stock *et al.* 2000; Stank, Keller & Daugherty 2001; Bagchi *et al.* 2005; Kim 2009; Alfalla-Luque, Medina-Lopez & Dey 2013). A good and efficient organisation requires a high degree of integrity in actions and programs related to outdoor activities, e.g. supply and distribution, and indoor ones e.g. production, storage and transfer. Thus, the degree to which an organisation's external integration actions and programs (including customers, suppliers and internal departments) work, reflects how much the organisation operates in line with its strategic goals. (Vargas *et al.* 2000; Alfalla-Luque, Medina-Lopez & Dey 2013; Pinmanee 2016).

Barki and Pinsonneault (2005) defined enterprise integration as the degree to which organisational components form one united whole unit. The components represent functional units in the process chain organisation. Increased responsiveness between interconnected functional units and quick access to detailed messages for highly integrated units are results of integration implementation. They also conclude that integration between functional organisation components can have different levels of effort required to implement and in terms of organisational processes that support integration. For example, internal operational integration can generally standardised business processes and lead to a more efficient organisation. Instead of side activities and flows between these activities, emphasis will be on the integration of the functional organisational activities (Berente *et al.* 2009).

#### 2.4.4.1. Intra-organisational integration

Business integration can take place at the intra-organisational and inter-organisational levels (Romano 2003). Intra-organisational integration helps to overcome the boundaries of functional areas and integration activities related to the management and business process redesign among the individual members of the supply network, including functional integration, rationalise internal processes, integration of internal information systems.

Functional integration has a close relationship with organisational integration. Cross-functional integration between different departments shows an important aspect of organisational structure in the field of cooperation between various functions (O'Leary-Kelly & Flores 2002). Researchers support the idea that there is a relationship between functional integration and organisational performance. This relationship can be controlled by strategy and organisational environment. For instance, some of the researchers believe that interaction between the level of integration and business strategy has a direct and positive effect on its performance. Foerstl *et al.* (2013) worked on the idea of cross-functional integration and functional coordination and their effects on firm and purchasing performance. They defined cross-functional integration as a collaboration of product development, production and manufacturing, purchasing and supply management and other related functions related to performance concepts. Gomes *et al.* (2003) proposed a number of items to measure functional integration in three main areas of interpersonal relations, communication and task orientation. Another type of integration in the organisation is integration, which is between departments. Although inter-departmental integration is one of the most crucial factors in product development, there is no clear definition for it. There three types of definition into it. The first approach defines it as activities related to interaction and communication, while the other approach considers inter-departmental integration related to collaboration. This means that departments will work together on common objectives in both approaches. The third group also insist on multi-dimensional integration attributes and they consider it as both interaction and collaboration processes (Kahn & Mentzer 1996). Integration needs interaction, the use and flow of information between departments. This means that managers integrate their departments through information flows (Kahn 1996).

Taking interaction and collaboration as separate processes makes it clear that different situations may need different degrees of interaction and collaboration to achieve successful performance. Effectiveness depends on the state of relations between the departments; as a result, to varying degrees of interaction and collaboration require achieving the best performance in different conditions. It can be understood that managers should not think that a situation needs to be more integration or less, but should think whether a state needs less or greater interaction and cooperation between departments (Armoon 2013).

#### 2.4.4.2. Inter-organisational integration

Inter-organisational integration aims to overcome the boundaries of individual organisations. This can be regarded as the initial expansion of integration (between two companies) and an advanced extension of integration (the whole supply chain) (Romano 2003). It can start with intra-company integration as a prerequisite. In fact, one of the main obstacles to the full integration of material and information flows in the supply network is related to inadequate internal management systems in separate companies. Some of the drawbacks in companies are the lack of standardisation of code and data accuracy, high-level multicast information flows, lack of integration between information systems running in an organisation, problems and low levels of logical interconnection and standardisation of operational processes (Romano 2003).

Inter-organisational integration can be *vertical* or *horizontal*. Vertical integration can be defined as the extent to which organisations take ownership of the different stages of the supply chain (Peyrefitte *et al.* 2002). According to Nugent and Hamblin (1996), vertical integration is when a product or service from one of its departments transferred to another so that sell it in the market without any major change. In addition, the integration between businesses located in different stages of channel perceived as vertical integration. Vertical integration is about cooperation between capable firms and organisation in every stage of the channel. More integration between physical and information flows between producers and distributors can improve and optimise the level of service and the average inventory (Caputo & Mininno 1996).

On the other hand, vertical integration can also be defined as the range of activities involved in the production and sales of products, which are part of the supplier companies. Desai and Mukherji (2001) refer to vertical integration as the degree of operations internalisation in organisations. It is motivated by the considerations of transaction costs, strategic considerations, input or output cost related interests and uncertainty in costs and expenses.

Different from vertical integration explained above, horizontal integration takes place between organisations that are on the same market or sector. Desai and Mukherji (2001) state that horizontal integration is related to coordination between organisations at the same level within a distribution channel. Thus, this type of integration requires more cooperation between producers and distributors to justify the need for integration. Most of the proposed solutions for integration can be simply done through one by one cooperation which is close to horizontal cooperation because transferring to horizontal integration can create multiple and complex relationships (Caputo & Mininno 1996).

### 2.4.5. Institutional support

Institutional factors including regulations, legal environment and government support can also be influential to supply chain integration and performance (Cai, 2010; Lau, 2002). Despite the impact of institution support on logistics integration has been considered (Rietveld & Stough 2005; Legacy *et al.* 2012), no research has been done to the port sector (Monios 2016). Most of the studies on the institutional impact on logistics and transportation have concentrated on the issue of governance, which can be characterised as a demonstration or procedure of governing. In the past, the term governance has been traditionally used in the literature, though in the most recent two decades, the term has been replaced by the government (Jordan *et al.* 2005).

Since government policy can have a considerable impact on different stakeholders, it needs to be incorporated into business strategies and relationships supported by government laws. In the Iranian port sector, many different authorities make policy decisions including the Port and Maritime Organisation (PMO) which implements regulations for all Iranian seaports. The government is also an effective power in regulating port relationships among parties (PMO 2016a). Chen and Cai (2011) introduced the other type of institutional support: financial support, providing loans and structured payments. In the Iranian case, this issue is significant in terms of helping provide infrastructures and equipment that are needed to develop the logistics system and meet standards of neighbouring ports. Educational and training activities are the other types of support which all entities in the supply chain need to function and collaborate efficiently (Habib 2014). That is why educational organisations currently offer significant support to the supply chain members both in terms of providing widespread literature on related topics and actively offering courses, research activities, seminars and conferences (Pinmanee 2016). Through the lens of institutional theory, institutions are an influential part of integrated logistics systems through the concepts of shaping choices, perceptions and behaviours and institutions can be considered as norms, roles, social arrangements, governance structure and ways of thinking. In addition, other researchers argue that institutional forces (such as government, financial institutions and educational centres) affect the firm's operational processes through logistics integration practices (Scott 2008).

### 2.4.6. Resource Sharing

Resource sharing activities and coordination between resources and logistics chain members are one of the main concerns in logistics and supply chain integration (Yao *et al.* 2007; Alfalla-Luque, Medina-Lopez & Dey 2013; Karia & Wong 2013; Adams *et al.* 2014; Xu *et al.* 2014). Based on Resource Dependency Theory (RDT), handling the external dependencies and resources (both in physical and skill-based) with supply chain partners can decrease uncertainty (Denktas-Sakar & Karatas-Cetin 2012). In the logistics and supply chain context, RDT suggests supply chain partners tend to be dependent and collaborate with each other; their collaboration can guarantee greater performance improvements in the long-term period (Pinmanee 2016). RDT suggests resource-sharing activities would be one of the crucial practices to achieve an integrated logistics system.

Generally, resource sharing is related to the readjustment of decisions and resources in both intra- and inter-organisation levels. It depends on the relationships and decisions between departments based on trust and commitment (Alfalla-Luque, Medina-Lopez & Schrage 2013). Few studies considered different aspects of resource sharing. Bagchi *et al.* (2005) considered decision-making processes between parties; specifically, the involvement of logistics chain members in the decision-making process and delegating the logistics chain members with the best negotiation position to lead the relevant decision making. Quesada, Rachamadugu, Gonzalez and Martinez (2008) highlighted four other aspects of resource sharing including work realignment, packaging standardisation and customisation, outsourcing reorganisation and logistical equipment sharing. Work realignment concerns planning the workload in a balanced way among the links in the logistics chain (Quesada, Rachamadugu, Gonzalez & Martinez 2008). Packaging standardisation and customisation are related to facilitating the design and packaging process for high quality and minimised costs. Outsourcing reorganisation is about searching for possible contracts to outsource logistics activities such as logistics providers. Logistical equipment sharing pertains to the extent to which different parties commonly use transportation, packaging and containers to facilitate logistics operations and significant cost saving strategies for logistics chain members (Beinke *et al.* 2017). According to Cagliano *et al.* (2006), agreements on delivery regularity are another aspect of resource sharing which have a large impact on speed, cost and quality. However, this would not be the same for each logistics chain member and it depends highly on the mutual interest of each party involved in the process (Bagchi *et al.* 2005).

Table 2.3 summarises the key studies in logistics integration, which are categorised based on their objectives, methodology, influential factors and the key findings.

Table 2.3. Summary of key studies on logistics integration

| Author | Focus/Objectives | Methodology | Influential factors in logistics integration | Key findings and limitations |
|---|---|---|---|---|
| **(Tseng & Liao 2015)** | A theoretical framework to investigate the relationship between supply chain integration | Survey on 124 container shipping firms (factor analysis) | Strategic collaboration with partners, Information exchange, interdepartmental collaboration, transportation collaboration | IT application and market orientation positively affect supply chain integration and market orientation and positively influence on firm performance. |
| **(Wilmsmeier & Notteboom 2011)** | evolution of maritime networks in and between two differently developed regions: the trade route and networks between the West Coast of South America and Northern Europe | Conceptual study with secondary data | Vertical integration | Vertical integration changes in the strategies of liner shipping Networks, Port infrastructure plays a strategic role in the development of liner shipping networks, hinterland development can impede or undermine the development of hub-and-spoke networks. |
| **(Heaver *et al.* 2001)** | Vertical integration in shipping line companies in terms of geographical span, the range of | Propose a conceptual framework | Geographical span, the range of of services and operations scale | Terminal operations integration will be value added if there were sufficient traffic of containers |

| | | | | |
|---|---|---|---|---|
| | services and operations scale | | | |
| **(Song & Panayides 2012)** | Supply chain integration and performance relationship in a port logistics context | Review study | Important factors in logistics integration: Inland logistics operations, value-adding services, integrated transportation services, service quality and service range | Liner companies will be integrated to be resilient to the industry environment under the following conditions: low-profit margins, extensive capital investment and high demand fluctuations |
| **(Panayides & Song 2008)** | Propose measures for evaluating seaport container terminals integration | Survey (factor analysis) | Information and communication systems, value-added services, multimodal systems and operations and supply chain integration practices | Four validated variables in integrating seaport container terminals have been identified: information and communication systems, value-added services, multimodal systems and operations and supply chain integration practices |
| **(Song & Panayides 2008)** | Defined parameters for global supply chain and port/terminal integration | Survey (regression analysis) | Use of information and communication Technology, Value added service, Relationship with shipping line, Integration of transport modes, Relationship with inland transport | Elimination of wastage and cost reduction in operations (like just in time (JIT)), communication, inter-connectivity and inter-operability of modal infrastructure and operations and provision of value-added services and customer satisfaction are identified as effective factors |

| | | | | |
|---|---|---|---|---|
| | | | Operators, Channel integration practices and performance | |
| **(Woo & Pettit 2011)** | Framework for analysing port performance | Survey (SEM- CFA) | | Internal view (operations), logistics view (intermodal and value-added services) and external view (customer orientation and service quality) |
| **(Woo *et al.* 2012)** | The relationship between supply chain strategies and port performance | Survey (SEM- CFA) | | Port supply chain integration have an impact on port supply chain integration and port supply chain integration contribute to logistics port performance |
| **(Notteboom, 2002)** | Vertical and horizontal integration in container shipping operators and market contestability | Using secondary data | | Entry and exit from Contestable markets lead to efficiency, even if there few firms |
| **(Marlow & Casaca 2003); (Paixão & Bernard Marlow 2003)** | Adopting logistics factors to evaluate port performance based on cost measures (lean) and responsiveness (agile) factors | Review studies | | The new method includes operations systems, infrastructural resources and logistical goals such as meeting customer requirements |

| | | | | |
|---|---|---|---|---|
| **(Bae 2012)** | Investigating the relationship between environmental uncertainty, logistics information systems, internal-external logistics integration and customer service performance in port logistics firms | Survey (SEM) | Internal integration in liners and international freight forwarders and external integration with their partners | Positive effects of environmental uncertainty on internal integration, logistic information system on logistics integration, internal integration on external integration, internal integration on customer service performance, external integration on internal integration and indirect effect of external integration on customer service performance |
| **(Stock *et al.* 2000)** | Fit between Enterprise logistics integration in capabilities in organisation and supply chain structure | Survey (SEM) | Functional logistics, integrated logistics, inter-firm logistics, enterprise logistics which is a combination of internal and external logistics activities in organisations. | Internal-external approach to logistics integration: an internal approach refers to higher levels of internal integration would include increased coordination of logistics activities with other departments in the firm, increased communication. External integration refers to the integration of logistics activities across firm boundaries and by the extent to which the logistics activities of a firm are integrated with the logistics activities of its suppliers and customers. |
| **(Chen *et al.* 2009b)** | Focused on supply chain process integration key | Review paper | Key views: Internal external perspective and Process view | Business process management defined as “a structured approach to analyse and continually improve fundamental activities |

| | | | | |
|---|---|---|---|---|
| | views and key drivers | | Key drivers: Cost orientation and customer orientation | such as manufacturing, marketing, communications and other major elements of a company's operation." With a process approach, the focus of every process is to meet customers' requirements through effective management of the processes. - Cost orientation: linking and simplifying supply chain processes presents an excellent opportunity to reduce both transaction-related costs and production costs. - Customer orientation defined as a set of beliefs that puts the customer's interest first and a sufficient understanding of one's target buyers to be able to create superior value for them continuously |
| **(Agan 2011)** | Assessing the impact of operations, marketing and information technology on SCI | Survey (SEM) | Partner selection, IT infrastructure, market orientation and collaboration has a direct effect on supply chain integration | conceptualised supply chain integration as a higher-level process integration capability |
| **(Prajogo & Olhager 2012)** | Assess the relationship between information integration, long- | Survey (SEM) | Inter-organisational logistics activities, integration strategies with suppliers, transportation and | The positive relationship between external logistics integration, long-term relationship and information integration. The study highlights two aspects of |

| | | | | |
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| | term relationship, logistics integration and competitive performance | | warehousing facilities both in and out of the organisation | information integration, IT capabilities and information sharing on logistics integration and they have equal importance. The direct impact of a long-term relationship on competitive performance is not mediated by information integration and logistics integration. Future studies are advised to work on bi-directional flows of material and information. (not only backwards and forward directions)<br>Limitations include firm size and only focus on one region (Australia) |
| **(Mellat-Parast & Spillan 2014b)** | Analysing logistics and supply chain process integration (information and process integration) in order to reach competitive advantage | Survey (SEM and CFA) | Information integration: integrated computer system data with channel members, integrated networks between computers and channel members<br>Process integration: Overall strategic planning, customer service program and the coordination with other logistics activities also result in a competitive edge relative to the competition | Logistics strategy is the main factor in supply chain and logistics integration and the most effective factor in the competitive advantage of the firm is logistics/ supply chain integration. Further researches can be applied in other contexts to validate the model and hypothesis of the study |

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| **(Bourlakis & Bourlakis 2006)** | Investigate logistics integration process of information technology strategies to figure out the important factors in retailer's distribution and operational performance | Survey (interview and secondary data analysis) | The integration process from developing a logistics strategy and set the IT and logistics operations, then establish integrated distribution which can reach operational efficiency and finally retailers' profitability | Financial analysis shows that multinational firms have greater operational efficiency. |
| **(Alam, K. Bagchi, *et al.* 2014)** | Investigate the relationship between supplier involvement (SI), length of supplier relationship (LSR), information technology (IT) with logistics integration (LI) to reach supply chain performance (SCP) | Survey (SEM) | Inter-organisational logistics activities, coordination of logistics activities, inbound and outbound distribution, information and material flows with suppliers | The direct effect of SI LSR and IT are insignificant to SCP, while LI has a direct effect on SCP. IT and LSR are indirect effects on SCP in India and Brazil and SI has an indirect effect on SCP.<br>Limitations: limited number of sample size and all the participants are belonging to manufacturing companies. |
| **(Uusipaavalniemi & Juga 2008)** | Develop a framework to investigate information integration in | Case study (structured interviews, workshops and company visits) | This study considers information integration as part of process integration. Information integration attributes information | A conceptual framework and criteria for the analysing level of information integration have been developed it illustrates which information, how, when should be shared in the investigated case. |

| | | | | |
|---|---|---|---|---|
| | maintenance services | | technology use, collaboration foundation, time-related issues, process and activities, information sharing practices, | Limitation: generalising the results of these study cannot validate in other contexts and industry |
| **(Bennett & Klug 2012)** | Works on supplier logistics integration in the automotive industry to classify and compare different types it | Survey (semi-structured interview and site visits) | Five conditions: geographical proximity, delivery contents, volume and sequence, shared investment and asset specificity, information sharing information technology system integration and transport system | All five dimensions were supported by analysis. Geographical integration emerges as the most suited strategy.<br>For future researchers, a holistic and comprehensive view can be applied to evaluate more strategic parts of supplier logistics integration. |
| **(Gimenez 2006)** | Test analyse integration process which is followed by firms in implementing supply chain management in manufacturing industry | Survey (EFA) | Internal integration logistics-production, internal integration logistics marketing, external integration<br>Teamwork, idea sharing, joint planning, joint establishment of objectives, joint responsibilities understanding and joint | Three different stages of integration have resulted in this study: the first stage: no integration in companies, second stage: medium-high level of internal integration and in the third stage high integration in internal and external activities.<br>Limitations: just one side of (manufacturer-retailer) supply chain players have been investigated not the whole supply chain |

| | | | | |
|---|---|---|---|---|
| | | | designs to improve cost efficiencies | |
| **(Fabbe-Costes & Jahre 2008b)** | Review logistics/ supply chain integration and its effect on firm performance | Systematic literature review | Four layers: integration of flows (physical, information and financial), integration of process and activities, technologies and systems integration, actor's integration | The role of logistics/ supply chain integration in performance was mentioned in almost all the studies have been investigated in this paper.<br>Limitations: the paper has not discussed the items of supply chain integration. |
| **(Narayanan *et al.* 2011)** | Focusing on business process integration (both internal and external) and business process outsourcing on firm performance | Survey (SEM) | Internal process integration: inter-departmental task coordination, In-house process integration and joint management and quality control<br>External process integration: Process coupling between the firm and its clients | The study highlights the importance of internal and external process integration in service operations context and its impact on firm performance.<br>Future researchers can work on multi-cultural differences in multi-country settings. The data collection can be done in whole supply chain actors although in this paper, not all the actors are involved in the data collection process. |
| **(Prajogo *et al.* 2015)** | The relationship between supply logistics integration, supply performance, lean processes and | Survey (SEM) | Internal-external integration (Inter-organisational activities, relationship and integration with suppliers, excellent transportation, | There is no significant relationship between supply logistics integration and competitive operational performance, but the relationship is fully mediated by internal lean production process and inbound supply performance. |

| | | | | |
|---|---|---|---|---|
| | competitive advantage | | distribution and warehousing facilities) | Further researches should cover other drivers of a lean production process rather than supply logistics integration is still uncovered and needs to research more on it. Rather than inbound logistics integration, outbound factors should be investigated to provide a better picture of integration in the supply chain network. |

## 2.5. The Impact of logistics integration

Most of the studies on logistics integration are focused on its impact on firm performance. For example, Gimenez and Ventura (2005) investigated the effects of logistic integration on performance where internal integration of logistics marketing and logistics-production boundaries and their relationship with external integration have been measured. The results of their study show that internal and external integration has affected each other. In particular, marketing integration does not lead to improved performance whereas logistic production can improve performance.

Lai *et al.* (2008) developed a new approach called electronic integration in the logistics field, looking to determine the impact of it on logistics performance. Electronic integration refers to intra- and inter-organisational activities and relationships. Spillan, McGinnis, Kara and Yi (2013) studied the impact of logistics strategy and logistics integration on firm competitiveness in the USA and China, finding that if logistics strategy is combined with logistics coordination effectiveness and customer service effectiveness, then it will contribute to organisational effectiveness.

Lee *et al.* (2009) used interviews of companies in the machinery industry to analyse the impact of global logistics integration on localisation service and business competitive advantage. The results indicate that logistics integration strategies can bring competitive advantage for companies. Improved logistics integration will enhance the utilisation of time and space, allowing for the necessary products to reach all points in the chain efficiently (Prajogo & Olhager 2012). What's more, it allows the firm to manage orders in the shortest time and at the lowest cost (Christopher 2005). Therefore, considering different studies, it can be inferred that performance measurement factors such as logistics, business, supply chain and operational performance are studied by a large number of researchers (Stock *et al* 2000; Rodrigues *et al* 2004; Robertson 2006; Alam, Bagchi, *et al* 2014). However, in some cases, logistics integration has been a result of the different factors (Spillan *et al* 2013; Prajogo *et al* 2015). Table 2.4 shows the various impacts brought about by logistics integration.

Table 2.4. Factors affected by logistics/ supply chain integration

| **Studies** | **Factors affected by logistics integration** |
|---|---|
| **Stock *et al.* (2000)** | Organisational performance |
| **Rodrigues *et al.* (2004)** | Logistics performance |
| **Robertson (2006)** | Business performance |
| **Prajogo *et al.* (2015)** | Inbound Supply Performance, lean production processes, and competitive performance (Indirect) |
| **Prajogo and Olhager (2011)** | Strategic supplier relationship and information integration to logistics integration- Operational performance |
| **Narayanan *et al.* (2011)** | Business process integration and firm performance |
| **Mellat-Parast and Spillan (2014b)** | Logistics process integration and competitive advantage (RBV) |
| **Chen *et al.* (2009b)** | Strategic priorities-supply chain process integration (internal and external)- supply chain capabilities- Performance (financial, Market) |
| **(Alam, Bagchi, *et al.* (2014)** | Supply chain performance |
| **Moshkdanian and Molahosseini (2013)** | operational cost reduction, improvement in customer services, improved financial and organisational performance, improved business performance and potential for contingency in the decision-making process |

## 2.6. Logistic integration in the seaport sector

### 2.6.1. Seaport logistics

Seaports are considered commercial, historic and infrastructural assets, which form the backbone of national and regional economies. They carry out a wide range of services and activities on domestic and international levels. Alderton and Saieva (2013) state that port functions can be divided into three main groups: administrative functions, operational functions and civil engineering functions. Administrative functions focus on port commuting control, environmental control, safety and security, dangerous goods, and customs control. Operational functions include the use of berths and sheds, loading and discharging storage and cargo distribution, pilotage, tugging, and mooring activities. Civil engineering activities encompass infrastructure development, sea and land access, road and rail network, and industrial area management. In another category, port services can be divided into three main activities and functions: marine services (nautical infrastructure), terminal services (quay and berth infrastructure), and logistics and value-added services (port superstructure) (Bichou 2014). In sum, providing the base (infrastructure) for the seaports is the most important function.

Traditionally, ports are considered as an interface between sea and land transport, providing short-term storage, shelter and berthing space as well as infrastructure for logistics and cargo handling activities (Cullinane *et al.* 2002). Due to the complexity of logistics chain activities and relationships, logistics chain partners — such as shipping lines, terminal operators, transport operators (rail, road and freight forwarders), port authorities and shippers — seek to extend their positions in the logistics chain (Notteboom & Rodrigue 2005) and improve their roles as key players (nodes) with additional integration levels in logistics networks (Ascencio *et al.* 2014). Port authorities are usually governmental organisations that mostly deal with port infrastructures. Shippers or consignees are downstream actors (customers) in the port logistics chain. Shipping lines are considered upstream supply chain members, in charge of the efficient and agile unloading and loading of cargos. Terminal operators are usually paid concession fees (as a contractual agreement) to port authorities for the privilege of handling terminals. Transport operators provide transportation facilities for handling cargos. In an efficient port logistics chain, transport services (i.e. transport operators, terminal operators and logistics service providers) are considered as links and transport infrastructures (ports) are considered as nodes. According to recent ideas such as port-centric logistics (Mangan *et al.* 2008), ports can play a significant role in adopting strategies, coordinating and leading the links, developing value-adding services, targeting more operators from different business sectors (instead of just shipping lines), managing relationships with institutions (Ng & Liu 2014) and generally integrating relationships and activities in the port logistics chain.

In addition, the relationships between seaport actors can be seen in terms of the physical transfer of goods, information exchange and financial flows between them. The physical flow consists of the transport and handling of goods along the port logistics chain which begins with downstream transport from the sourcing location to the production or assembly location to the end-customer. As explained briefly in the second paragraph of this section, Van Baalen and Zuldwijk (2008) categorised port logistics processes and steps into 14 activities. These activities include (1) downstream transport from sourcing location to production or assembly location; (2) production or assembly; (3) the container is picked up from the empty container depot; (4) stuffing the container with the goods; (5) inland pre-carriage; (6) changes between deep-sea container vessel and continental transport modes (Steenken *et al* 2004; Stahlbock & Voß 2008); (7) sea transport; (8) terminal transhipment takes place and the container is temporarily stacked; (9) inland on-carriage from sea to land; (10) transhipment in-land stripping the container value-added logistics; (11) goods are transported from the distribution centre to the retailer; (12) delivery at the consignee; (13) return the container to depot; (14) delivery to final customer.

In order to have integrated logistics, having an efficient flow of information is an instrumental step. Numerous information exchanges need to occur to support fast and reliable information exchange among internal and external partners in the logistics chain. In order to convey one container from point of origin to point of destination, tremendous care is needed on the part of more than 40 different parties involved (Baalen and Zuldwijk 2008). The last main flow in logistics is related to financial flow or money transaction between parties involved in the logistics chain. Financial institutes such as banks and other logistics chain partners such as forwarders, insurance companies and consignees are involved in the financial transactions between logistics chain parties (Van Oosterhout 2000), but these transactions do not necessarily follow information and physical flow (Van Baalen and Zuldwijk 2008).

### 2.6.2. Port logistics integration concept

Traditionally, ports play a central role in cooperative relations among port logistics partners (e.g. providing infrastructure, setting the strategic plan and loading/unloading cargo). More recently, they are considered clusters of organisations that aim to create value for the supply chain (Song & Panayides 2008). Logistics integration in the port sector has rarely been the subject of in-depth research (Song & Panayides 2008).

According to Tseng and Liao (Tseng & Liao 2015), port logistics integration is important for two reasons. Firstly, the focus of the supply chain in manufacturing companies is on supplier integration, while, in service supply chain or specifically in port logistics the role of partner integration (like ports and container shipping firms) is much more important. Secondly, the port supply chain is more complex than the manufacturing supply chain due to its global service features and the uncertainty of market and customer demands. According to Wilmsmeier and Notteboom (2011), supply chains in ports are becoming more market-driven due to the need to respond to increasing demands of customers in this sector.

Integration of contemporary terminals in global supply chains is essential and it is expected to improve performance and competitive advantages of the port (terminal). This follows logically from the understanding that the role of modern seaports involves integration in the supply chain and fulfilling this role means the greater ability of the port to satisfy customers and achieve its objectives (Song & Panayides 2008).

There are different objectives of port logistics integration. Generally, it is about increasing the value of goods and minimising logistics costs (in storage, vessels loading/unloading cargos and distribution functions) to create high added value processes (Bae 2012). From the internal-external perspective, it can be defined as "generated collaboration and interaction from their management of resources such as human, physical and flow of information". Song and Panayides (2008) show that port logistics integration is about well-coordinated relationships with port logistics actors and functional activities in the port environment in order to create value to port services and cargos receiving to the port. According to Bichou and Gray (2004), logistics integration in ports can be defined in two different perspectives. The first perspective pertains to intermodalism, which defines as inter-links between nodes and transport modes in the port logistics system. The second one is related to organisational integration and partnership, which is about logistics channel restructuring and considering the relationship between port logistics chain partners.

Panayides and Song (2009) attribute port logistics integration definition to effective collaboration of four functions in logistics system of the port information and communication systems, value-added services, multimodal systems and operations and supply chain integration practices. Notteboom and Rodrigue (2005) note the importance of inland terminals and relationship between different ports in a region to develop the level of port logistics integration. More recently, Wilmsmeier *et al.* (2015) defined port hinterland integration as a cooperative relationship between custom clearance, rail regulations, cargo security and land acquisition.

To sum up, port logistics integration can be divided into integration of functions and actors in the port sector that will be further studied in this study. Integration of functions relates coordinating functions such as information, value-added services supply chain integration practices and operational or physical activities in the port, while integration i.e. collaboration between different parties in port logistics systems such as shipping lines, logistics service providers, rail and road system, port authorities, consignees and terminal operators.

### 2.6.3. Trends in port logistics integration

A small body of literature has examined the trends in logistics integration in the port sector in terms of the causes, patterns and implications (Heaver *et al.* 2000; Notteboom & Winkelmans 2001; Robinson 2002). The integration of ports in the concept of logistics and supply chain management is discussed in detail by Bichou and Gray (Bichou & Gray 2005). They study the validity of the conventional terminology for classifying seaports, questioning the assumption that ports should be conceptualised as separate markets and distinct operational and business ventures. Bichou and Gray (2005) also conceptualised the role of ports from three perspectives. Firstly, from a logistics channel perspective, the port plays a role of a node in the intermodal/multimodal transport intersection and operates as a logistics centre for the flow of cargo/passengers. Secondly, from a trade channel perspective, the port is a key location whereby channel control and ownership can be identified and/or traded. Thirdly, from a supply channel perspective, the port not only links outside flows and processes but also creates patterns and processes of its own. In this context, ports can act as networking sites bringing together other members of the supply chain.

Despite existing research mainly focuses on the effect of supply chain integration on port performance, little has been done on the relationship between logistic integration and port performance. Bichou and Gray (2004) showed that logistics integration in the port sector involve the extent to which the port plans and organises activities, processes and procedures beyond its boundaries and monitors performance in such activities. Their findings, however, were discouraging in that most respondents in the particular survey did not seem to understand/appreciate the issue of port integration in the supply chain channel. Notteboom and Rodrigue (2005) show that such practices may include involvement in the introduction of new shuttle train service to the hinterland, together with the respective national railway companies, rail operators, terminal operators, shipping companies and/or large shippers. In addition, it includes the extent to which port management collaborates with other members of the supply chain in order to identify cost-effective solutions for the goods passing through the system.

Tseng and Liao (2015) investigate the relationship between supply chain integration, information technology, marketing integration and firm performance in container shipping companies in Taiwan. The study of a sample consisting of more than hundred container-shipping companies to evaluate mentioned factors relationships through structural equation modelling found companies with marketing and IT-based structure easily can be integrated with other supply chain partners and it leads to better performance for the supply chain.

Song and Panayides (2008) studied the effect of supply chain integration on seaport competitiveness, including the use of information and communication technology, value-added services, relationship with shipping lines, integration of transport modes, relationship with inland transport operations, channel integration practices and performance. In Panayides and Song (2008), seaport container terminals integration has been analysed using a survey method to find factors to evaluate. Information and communication systems, value-added services, multimodal systems and operations and supply chain integration practices are four selected factors which describe container terminal integration. Song and Panayides (2013) investigate current issues in port logistics integration and suggest that liner companies need to be integrated to be resilient to the changing environment that is affected by low-profit margins, extensive capital investment and high demand fluctuations. Focusing more specifically on port integration with hinterland Wilmsmeier *et al.* (2015) argue that port integration with hinterland can be improved through inside-out and outside-in integration. It naturally involves the main parties in the port-hinterland relationship, i.e. port authorities, terminal operators and inland transport and logistics service providers. This may involve important factors including inland port development e.g.

modal shift, customs clearance and dwell time, land centres, metropolitan accessibility; rail regulations; customs clearance; cargo security; and land acquisition. Reviewing the literature in logistics integration and specifically in port logistics indicates that from theoretical and academic perspectives, different factors and aspects of logistics integration, such as the role of actors in the logistics chain and the role of organisational activities, institutional support and resource sharing in the port logistics chain, still haven't been addressed (Rezaei et al 2015; Pinmanee 2016; Bae 2012; Alfalla-Luque, Medina-Lopez & Dey 2013).

### 2.6.4. Influential factors in port logistics integration

As noted earlier port logistics integration can be divided into two main areas, namely functional integration (Song & Panayides 2008; Panayides & Song 2009, 2013) and actor (partner) integration (Notteboom 2008). Functional integration involves coordinating functions such as information, value-added services, logistics practices, operational/ physical integration, organisational activities, institutional support and resource sharing in the port. On the other hand, actor integration in port logistics systems brings to focus the need to effectively manage relationships between different parties (such as shipping lines, logistics service providers, rail and road system, port authorities, consignees and terminal operators).

Figure 2.3 shows the structure of a typical logistics system in which ports can help to improve its performance through the integration of logistics functions and logistics actors. The process begins with receiving cargos from ships through shipping lines, and then the cargos are organised by terminal operators in the hinterland. Because port authorities commonly set the laws and regulations of each port, they have a dominant impact on the logistics system. Transport operators (e.g. rail systems, transportation companies or inland waterways) transfer the cargos to their final destinations. There are two general ways to deliver cargo. The first way is via resource-based pathways which transfer cargos to distribution centres (e.g. dry ports, intermodal terminals, or general distribution centres) and after that transport it to the customers. The second way is via the industry organisation pathway; wherein many of the large manufacturers directly work with ports to transfer the cargos. Further expansion of port logistics chain actors, their relationships and influencing factors will be discussed in the next section. In particular, in the activities and functions section, the study will focus on a series of studies by Song and Panayides (2008) and the factors related to resources and infrastructures of logistics system which haven't been investigated before in the port context.

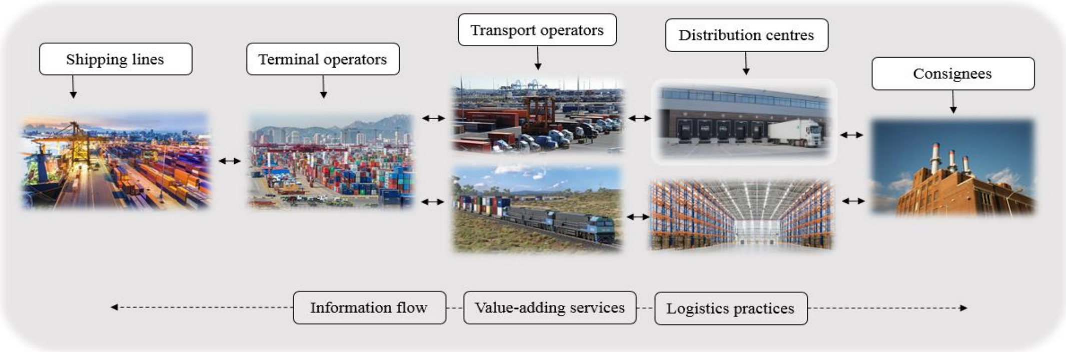



Figure 2.3. Port multi-level integrated logistics framework
(Source: Adapted from Almotairi (2012)

#### 2.6.4.1. Actors in port logistics integration

This section will discuss the chain partners, relationships and integration in the port logistics system. Kalwani and Narayandas (1995) claimed that long-term relationships with specific customers lead to sales growth and increased profitability. In addition, setting an appropriate governance structure in ports is critical to having acceptable synchronisation with partners. One of the valuable studies in this area was conducted by Carbone and Martino (2003), specifically concerning the potential role of ports in the automotive supply chain. They introduced ‘relationships between the port operators and the focal firm’, ‘supplied services that add value’, ‘information and communication technologies’, and ‘performance measurement’ factors as common variables to integrate supply chain partners. Paixão and Bernard Marlow (2003) and Marlow and Casaca (2003) worked on the lean and agile concepts in the port industry with the aim of improving firm performance. They proposed some factors in a framework to increase integration and add value to the port logistics chain. These factors encompass the capability to deliver suitable services, managing the capacity of sending cargo in terms of time and path length within an optimum time, changing processes and setting a flexible ordering method to meet customers’ expectations every time, and providing infrastructures in hinterland and foreland of the port to have suitable access to rail or road. According to Notteboom (2008), different parties are engaged in internal port activities including logistics service providers, transport operators (rail, road, barge and short sea), shipping lines, port authorities and terminal operators. Fabbe-Costes and Jahre (2008a) considered the partner's integration as one of the important approaches in logistics/supply chain integration. In this section, key actors in port logistics will be identified and discussed. Figure 2.4 shows different actors in the port logistics system and the relationship between ports as well as the actors of each port.

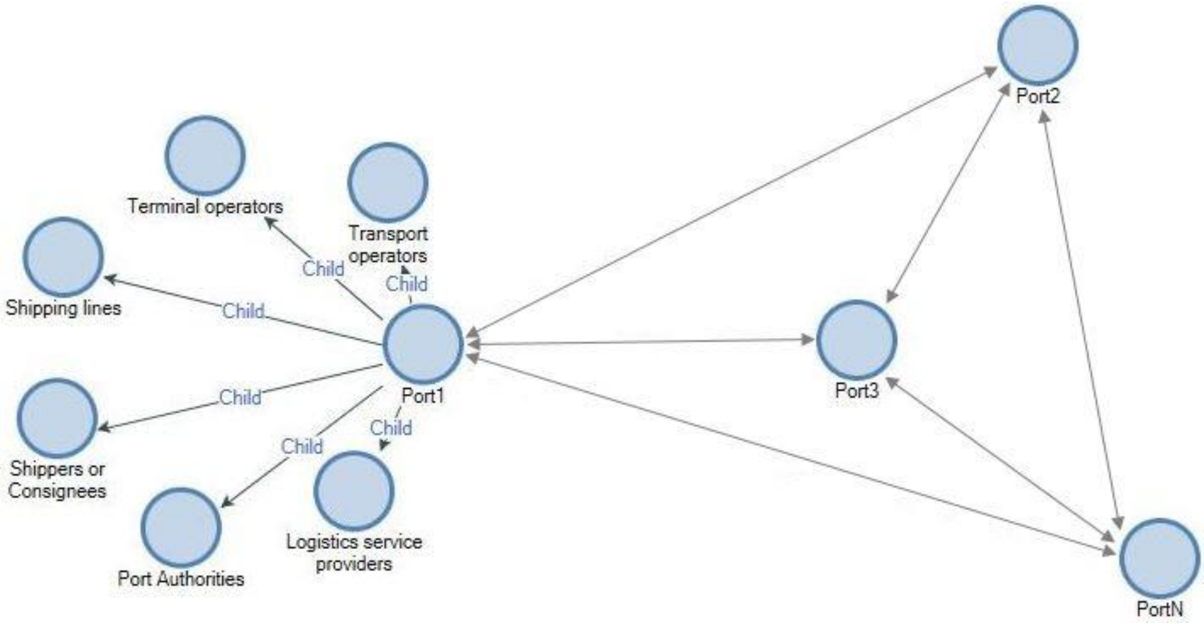



Figure 2.4. Overview of logistics integration in the port sector

**Logistics service providers (LSP)**

In recent years several studies have mentioned the increasingly significant role of logistics service providers (Fabbe-Costes & Jahre 2008b; Mortensen & Lemoine 2008; Chu & Yang 2010; Fabbe-Costes & Roussat 2011). Mortensen and Lemoine (2008) analysed the integration between manufacturers and third-party logistics. They focused on tools of information and communication technology (ICT), cooperation-oriented tasks and the services have been used by third logistics providers. The results show that there should not be increased competencies between Third-Party Logistics (TPL) providers. Lam and Zhang (2014) considered the role of the logistics service provider (LSP) in the integration of supply chains in port logistics. LSPs are responsible for quality service activities, for example, online distributions; fast, flexible, precise and accurate transfer times. They interviewed practitioners and academics to identify the success factors and they used Analytical hierarchy process (AHP) method to analysed cost-benefit analysis. The critical success factors were encompassed "Bargaining power, trusting beliefs in sharing critical information, transparent system for performance evaluation and incentives for parties to accept performance-based pricing mechanisms" are identified and discussed.

Chu and Yang (2010) investigated the role of third-party logistics in integrating logistics activities from supply chain integration perspective in the port sector. They used structural Equation modelling to examine more than a hundred companies which worked with third-party logistics providers and they found that commitment, trust and dependence are the factors directly impacts on logistics integration with 3pls. Fabbe-Costes and Roussat (2011) look at supply chain integration from logistics service providers view in which a single case study approach has been used in a company which claims to be a logistics integrator. The results of the study confirm the following concepts: significant role of LSPs in supply chain integration, the relationship between supply chain integration performance and the necessity to integrate LSPs in successfulness of supply chain theory.

**Transport operators (rail and road)**

Notteboom (2002) articulates that inland logistics (approximately 40-80 percent of the total costs) is one of the most important parts in reducing the costs of supply chains. For example, a properly implemented connection with rail systems is critical to port development. The advantages of this strategic partnership include: expanding the port hinterland; increasing the capacity without congesting the city environment neighbouring the port; and improving port competitiveness through economic and geographical aspects, industry structure, institutional structure and types of foreign trade (Leal & Pérez 2012). Seaports/terminals linkage with rail has been underdeveloped and constructing this structure could cost too much. According to nowadays-growing demands, bigger ships are should be used to deliver a greater amount of goods. These big ships need strong hinterlands and huge logistics modes such as inland waterways and rails. Inland waterways depend on the natural landscape and it is not available in every port. On the other hand, railway services in hinterland could be built everywhere provided that the volume of cargo transportation can cover construction costs (Chew *et al.* 2011). Dzawanda (2009) mentioned some benefits of port and rail integration (with a focus on landlocked countries) as follows: elimination of congestion in ports, improved transit times, fast turnaround of key rail operational resources, a decrease in logistics costs, increase business volume, improved utilisation of resources and improving the logistics chain. Kortschak (2011) in his article tries to eliminate the uncompetitive role of rails in port transportation. The main idea behind this method is load and unload a lot of cargos while the smaller part of hinterland use. In other words, the aim is to increase the profitability of ports with directly transferring the goods from vessels to trains and vice versa (Kortschak 2011). Increasing demands for goods transportation will impact on the growth of road transportation so that 50 percent growth is expected for the European Union by 2000-2020 (Psaraki-Kalouptsidi & Pagoni 2011).

**Shipping lines**

The port industry and shipping lines have been significantly evolving due to increasing market demand. Along with terminal operators, hinterland operators and port authorities, shipping lines are one of the most important logistics chain members to impact port logistics. Service differentiation and increasing market share have forced shipping lines to use integration strategies both vertically and horizontally (Van de Voorde & Vanelslander 2009). Some terminals use the combined method, offering spare sections of the ports to shipping lines and unloading services to third party logistics to maximise the efficiency of the ports (Notteboom 2006).

There are different types of integration between shipping lines and other sections. The first type is forward vertical integration like a terminal operating company getting engaged with port shipping, the second one is backwards vertical integration like shipping land investigating in inland transportation and the last one is horizontal integration which is between two shipping lines. The vertical integration will result in increasing control of port operations and improve the liner service level. Horizontal integration usually happens in different strategic forms like mergers, acquisition, alliances and vessel sharing contracts (Benaissa *et al.* 2003). The results of the horizontal integration would be a growth strategy for almost all the logistics chain partners. Heaver (2002) proposed a framework to describe the shipping lines role in international logistics. The responses of lines to challenging development include a geographical extension, service range and scale of operations. The lines interest to establish new connections with consignees and shippers will place extra force on collective pricing practices in liner shipping. Based on Panayides and Song (2013) shipping lines scope of work does not only related to ports. They expand the activities in logistics services and inland transportation. Some of the shipping undertake the dry ports as long as seaport extension strategies in which they controlled the rail operations.

**Port authorities and terminal operators**

Port authorities traditionally play the role of facilitator in the port sector. In recent years, they have been responsible for determining the regulations and providing infrastructures for loading/ unloading cargos, temporary storage, ship operations and totally intra-port activities (Song & Panayides 2008). Heaver *et al.* (2001) allocate the strategies for port authorities into one of two sections. The first one is about terminal concessions in which port authorities should know who the operator of the terminal is and what are the conditions of operation in terminals. The second one is about port strategies concerning the relationship between ports. Notteboom (2008) believes that port authorities aim at making the port attractive for the users by, providing a competitive supply of services for carriers and shippers. The attractiveness of the port is about making the proper connections with logistics partners. Despite the limitations for port authorities such as land shortage, road congestion, environmental issues and political and legislative issues, proper management and strategic plans can change the shortages to strength for the ports by land issuing, traffic management activities, hinterland connections and services, environmental protection and meet stakeholders expectations (Notteboom 2008).

Terminal operators provide facilities for the port environment such as wharfage, warehouses, docks and other terminal facilities to ocean common carriers moving goods to ocean-borne. There are two general forms of terminal operators public and private. In public operators, facilities like docks and other equipment also administrative works owned and handled by ports. In private ports, companies lease terminals from public port authority (landlord) and operate the port as a private business (FMC 2016). Generally, terminal operators are expected to strengthen their impacts by building a link between inland terminals and seaport terminals. There are few studies discuss the integration between logistics partners and terminal operators directly. One of the studies is related to Notteboom (2008) study, which proposed long-term contracts with logistics chain members such as shipping lines with gain sharing clauses, to increase the cooperation and integration between members. One of the common problems with the integration of large terminal operators is becoming more footloose in longitudinal terms as network approach loosens their former strong links with other terminal operators. The way to overcome this problem is setting proper strategies with current terminal operators and develop a strategy to make new relationships with newborn terminal operators to offer customers a more differentiated product range.

#### 2.6.4.2. Port logistics operations

As mentioned in section 2.3, different studies and influential factors have been reviewed. In a general context, the factors of information integration, process (physical) integration, organisational relationships, institutional support and resource sharing have been identified. Although few studies have considered the role of organisational factors, institutional factors and resources in a logistics chain, none of them has examined these in terms of logistics and supply chain integration in the port sector. The following sections explain in detail the key activities in port logistics integration.

**Value-added services**

The value chain idea is based on the organisational process view and considers the organisation as a system, in which inputs change to value-added outputs during processes to create value for customers. Porter (1985) divided process activities into two main areas: primary and second activities. Primary activities (inbound logistics, operations, outbound logistics, marketing and sales, services) are directly related to production or service, whereas secondary activities (procurement or purchasing, human resource management, technological development and infrastructure) play a role of support for primary activities (Porter 1985). Song and Panayides (2008) defined value-added services in port management context as “the ability of the port to add value to the services that it provides in the context of facilitating further the objectives of the supply chain system”. Robinson (2002) considered ports as value-driven chain systems. These systems deliver value to their customers such as third-party service providers and shippers. Paixão and Bernard Marlow (2003) put forward another approach to value-added services in the port sector. They mentioned some activities such as increase capacity in hinterland and foreland for better rail and road access, build and new smart services to handle different types of cargo, fast and smart systems to change the orders and design processes to reach to customers demand and variety of services in intermodal operations (Song & Panayides 2008). Bichou (2009) proposed Value-added logistics as a similar concept to value-added services which are defined value-added activities in logistics concept in an appropriate way. Besides, this concept is closely related to consolidation, storage, break-bulk and cross-docking concepts. Value-added logistics activities are related to post-production and pre-distribution stages of the logistics processes. Based on Bichou (2009)'s study value-added logistics components are encompassed following activities:

*Postponement*: Postponement is defined as the transference of one or some processes (manufacturing, resource finding and delivering) to another spot in the supply chain. There are two considerable points in developing the postponement strategy: determining the number of stages for postponement and determining the stages, which require a postponement. Postponement allows the organisation to have different flexible production in meeting customers' changing needs and product differentiation or change in demand function. Various kinds of postponement strategy and discussions about its benefits are introduced in debates of marketing, logistics and supply chain management. Alderson (2006) discussed postponement from the marketing viewpoint that put forward this theory as a promising reaction to demand uncertainties, which leads to dropping in costs (Alavi *et al.* 2014).

*Reverse logistics*: reverse logistics is related to managing and handling returned goods in general. Carter and Ellram (1998) defined it as a process in which companies become more efficient in recycling, reducing and reusing their used materials to help the environment. Another holistic view of reverse logistics includes mitigation of used material in the forward chain in order to receive less flow of returned materials (Carter & Ellram 1998). The process can add value to the system by returning used materials to the forward supply chain (Bichou 2009).

*Information technology*: Birks (1994) proposed value-added information systems as the art of synchronising with the corporation. He considered five steps as corporate development cycle: initiation, definition, development, verification and general deployment. His finding shows that there is a direct relationship between value-added information services and firm competitiveness and it can provide a growth path for organisations future. Activities like online documentation and payment services, real-time tracking and tracing for cargo distribution and inventory levels are considered as value-added activities in logistics (Almotairi 2012).

*Packaging*: packaging is defined as a coordinated system of preparing goods which have following features: efficient, effective, secure, safe for handling, distribution, storage, consumption and recycling to create maximum value for customers (Saghir 2002). Saghir (2004) suggested a procedure for analysis of packaging in logistics in four steps: the packaging system matrix, packaging basic requirement matrix, the packaging supply chain matrix and packaging logistics performance matrix. Packaging is considered as logistics value-added attributes. For example, dangerous, small, fragile commodities shipment can be a very high risk if there is no safe packaging (Bichou 2009).

Review of the literature revealed that value added services is defined by various components such as postponement, reverse logistics activities (Bichou & Gray 2004), Quality Assurance testing and inspection, price coding and barcoding, repair management (Rivera *et al.* 2016), information and communication values, multi-modal transportation value, critical asset value (Almotairi 2012), mode transfer, pre-assembly, manufacturing, packaging and changing design processes (Song & Panayides 2008).

**Information integration in the port sector**

As discussed in logistics integration section, information integration plays an important role in logistics integration. In this section, the role of information integration in the port industry has been discussed. Lam and Zhang (2014) proposed Electronic Data Interchange (EDI) as one of the efficient ways of information sharing methods. They proposed EDI system in three main steps: external factors (impact of industry and competitiveness), internal factors (firm size and technical competencies), plant factors (real-time and agile methods), expected benefits and dyadic factors (partners force). Using EDI can improve competence capability, cost-saving benefits and cooperation and coordination between supply chain partners. Klein and Rai (2009) examined information sharing in the supply chain from a strategic point of view. The results show that Information technology customisation, buyer dependence on supplier and trusting beliefs are the main factors in motivating and facilitating strategic information sharing. Panayides and Song (2008) proposed information and communication systems as an important factor which leads to supply chain integration seaport container terminals. They defined it as a seamless communication system which facilitates supply chain servicing operations inefficient way and helps to gain supply chain goals. Besides, information and communication tools such as VTS, EDI, Global navigation satellite systems, Radio-frequency identification (RFID), optical character recognition systems, wireless sensor networks, real-time location systems, and mobile services are essential in integrating the activities in the logistics chain (Heilig & Voß 2017). As mentioned in section 2.4.2 and this section, a wide review of the literature has identified numerous components that are essential to port logistics integration. These include information technology use, information attributes, information sharing practices, collaborative foundation, time-related issues, operational information sharing and value-added information functions (Uusipaavalniemi & Juga 2008; Almotairi 2012; Alfalla-Luque, Medina-Lopez & Dey 2013; Rashad & Gumzej 2014; Prajogo *et al.* 2015; Pinmanee 2016).

**Cargo handling operation in the port sector**

As shown in Song and Panayides (2008), ports have a bi-directional relationship with channel members and actors to transfer cargos from ships to the hinterland and then by three different transportation types (e.g. rail, road and inland waterway interfaces). On the other hand, the port receives goods and cargos from three different transportation ways to the sea leg to deliver them with ships. This bi-directional transportation needs a large amount of coordination and integration to optimise the logistics chain. Meixell and Norbis (2008) have investigated transport mode integration in a review paper. They find transportation capacity shortage, international growth, economies of scale and scope, security concerns and environmental and energy use as an important factor which effects on the integration of transport modes. In another study, Stank and Goldsby (2000) mentioned that the transportation managers must encourage their firms to consider total cost and total value in transportation process and the decisions must be made by considering these two factors. The strategic direction and goal of transportation parties should be considered as well during the transportation design making processes. Bichou and Gray (2005) put forward the importance of ports internal activities integration to facilitate multimodal transport intersections, handling and playing the role of logistics centres, value adding and linking information, physical and financial flow with supply chain partners. According to (Panayides and Song (2008); Song and Panayides (2008); Panayides and Song (2009)) in the process and operational part of logistics integration, multimodal systems and operations in one of the crucial factors in the process and operational part of logistics integration.

Multi-modal transport concept defines as “the carriage of goods by at least two different modes of transport on the basis of a multimodal transport contract from a place in one country at which the goods are taken in charge by multimodal transport operator to a place designed for delivery situated in a different country” (Cheong *et al.* 2006). One efficient way to implement multimodal operations is setting a specific system to most effectively handle the operations (Panayides & Song 2008). Four main features of multimodal systems include the transportation of goods with at least two or more modes, evidence of carriage-like documents from seller to buyer, one operator who is responsible for whole transfer journey, and goods carriage between two or more countries (Cheong *et al.* 2006). Transport operations can also be categorised into three types including: unimodal transport (goods are conveyed through one or more carriers using one mode of transport only); intermodal transport (one carrier operates the journey with several modes of transport from point of origin to destination); and combined transport (the transhipment of goods in the same loading vehicle using combination of modes such as road, rail and inland waterway).

There are different ways in ports logistics to convey goods. Ports can receive containers and goods from ships (through shipping lines) and distributed them through rail/road, air and other waterway systems. On the other hand, they can also receive goods from landside and convey them through ships. This bidirectional system needs a great deal of integration to handle the activities inefficient way (Panayides & Song 2008). Song and Panayides considered multimodal systems dimensions based on research which has been done by Paixão and Bernard Marlow (2003). Cargo handling operations have been used with different names in previous studies; for instance, relationship between logistics chain members or transport mode integration (Song & Panayides 2008) logistics operations and coordination (Pinmanee 2016), supply chain business processes (Almotairi 2012), process integration (Robertson 2006), Coordination activities (Alfalla-Luque, Medina-Lopez & Dey 2013), hinterland integration (specifically in seaport studies) (Wilmsmeier *et al.* 2015) and other similar titles. This study aims for a comprehensive view of the operational activities in the logistics chain and summarises operational integration activities into three main areas:

hinterland integration, relationship with partners, and logistics operations and coordination activities.

**Logistics integration practices**

Bichou and Gray (2004) studied logistics, trade and supply channels and identified different functions of each channel in the port system. Logistics practices include a number of activities that facilitate the efficient path of goods through supply chains such as shipping lines and freight forwarders. The trade channel is mostly considered as sector or industry level while the supply channel is perceived to be at a firm level. Although both are associated with the ownership of goods moving through an interacting organisation system, the study results showed that the respondents did not pay attention to the integration of ports in their supply chains. Logistics integration practices refer to plans, procedures and processes of the ports beyond its boundaries that maximise its performance. According to Notteboom and Rodrigue (2005), it is related to how port management collaborates with other supply chain partners to reduce the costs and find strategies to increase the performance of the supply chain. What's more, Song and Panayides (2008) highlight the importance of port integration in improved performance and competitiveness. Logistics integration practices include evaluating the performance of other possible modes of transportation such as road, rail and inland waterways to connect hinterland destinations, benchmarking logistics options to match with a particular port through alternative routes and identify least-cost options for cargo transportation. Lin *et al.* (2010a) worked on innovation factors in channel integration and supply chain performance. Channel integration dimensions in this study include value co-creation, embedding operant resources, resource integration and value constellation. The results show that value co-creation and value constellations are the most important factors. Oh *et al.* (2012) investigate the relationship between retail channel integration through information technologies on firm performance. The results indicate five most important factors in retail channel integration encompass integrated promotion, integrated transaction information management, integrated product and pricing information management, integrated information access, integrated order fulfilment and integrated customer service. Notably, logistics practices have been assumed as influential factors in logistics integration in a number of different studies (Bichou & Gray 2004; Notteboom & Rodrigue 2005; Song & Panayides 2008; Panayides & Song 2009). Logistics practices involve evaluating the performance of other possible modes of transportation (such as road, rail and inland waterways) to connect hinterland destinations. Such benchmark logistics options include providing customers with access to information available in one channel from another channel and offering support for customers to choose their preferred channel and complete their purchases (Aulakh & Kotabe 1997; Song & Panayides 2008; Lin *et al.* 2010b; Oh *et al.* 2012).

## 2.7. IMPACTS OF PORT LOGISTICS INTEGRATION

The literature has identified vast and significant benefits of port logistics integration. This includes cost reduction, increased efficiency, higher productivity, inventory reduction, decreased lead-times, enhanced customer service, and advances in prediction and planning. Stock *et al.* (2000) state that integrated logistics systems can be directly beneficial for supply chain structure and firm performance in the long-run. For instance, from an operational perspective, integrated processes can offer quick responses to final customer demands, lower inventory throughout the supply chain and lower costs in shipment activities (Cachon 1999; Barut *et al.* 2002; Armoon 2013). Comparing three different approaches in integrated logistics (independent, semi-integrated and integrated) reveals benefits such as reaching goals related to all logistics chain partners, decreasing lead-times and on-time delivery of cargos to consignees, lower final prices of products, as well as better quality and better services (Meenakshi Sundaram & Mehta 2002).

Studies that focus on port logistics systems have discerned similar benefits within this sector. In terms of information and communication integration in ports, research has identified positive business outcomes due to quicker access to information, improved communication between logistics chain partners, reduced operating costs and better service quality (Lambrou *et al.* 2008). A study by Tseng and Liao (2015) suggests other improvements relating to the application of IT systems, marketing performance and overall port performance. Integrated logistics could also have a useful impact on the efficient connections between logistics partners such as shipping lines, logistics service providers and inland transport operators. Port operations improvement and the satisfaction of stakeholders and specific customers are other advantages highlighted by Song and Panayides (2008). In addition, numerous researchers have reported positive effects of port logistics integration relating to competitive advantage, service performance and port performance (Panayides & Song 2008; Song & Panayides 2008; Ducruet & Van Der Horst 2009; Panayides & Song 2009; Bae 2012). According to Notteboom and Rodrigue (2005), transport/ logistics integration will result in different aspects. In strategic aspects, it can affect the coordination of strategic partnerships through a strategic alliance, joint venture, merger, acquisition or other similar strategies. From an operational perspective, it can help to reduce transport volumes and suitable inland connections specifically concerning the rail system.

## 2.8. LOGISTICS INTEGRATION CHALLENGES

Although few studies mentioned the challenges in logistics/ supply chain integration This section will review the limited studies and sources of challenges identified by researchers. Forslund and Jonsson (2009) studied supply chain integration challenges in three levels: relationship with suppliers (lack of trust, different goals and priorities and lack of parallel communication structure), an operational tool (manual performance data management and non-standardised performance metrics) and control variable (company size and supply chain position obstacles). Based on another perspective supply chain integration challenges can be classified into three streams: technical, managerial and relationships streams (Awad & Nassar 2010b). Carter *et al.* (2009) reviewed many stories of failures and breakdowns in supply chain integration practical studies and the results were due to variety of barriers such as lack of comprehensive cost reduction plans, lack of strategic directions, focus on functional and short-term goals, focusing on one-layer supply chain activities without considering complex supply chain activities. As mentioned earlier, due to the complexity of relationships and port logistics networks, institutional, organisational and governance challenges has mentioned by several researchers in recent years (Monios 2016; Pinmanee 2016). Besides these challenges, recent studies are focusing on e-integration barriers (networking) in logistics chains such as making the link between e-integration and performance, developing internal networking tool and developing IT infrastructure for each member in the supply chain (Frohlich 2002; Richter & Walther 2016). To summarise the challenges in logistics and supply chain area in the literature, they can be categorised in five factors: infrastructural challenges, governance and policy challenges, operational/ technical challenges, managerial/ organisational challenges and challenges related to sanctions.

Although investment in the maritime sector is one of the most profitable economic activities and the return on capital is taking place within two to three years, it is always challenging to attract organisations, institutions or private sector companies such as logistics providers to invest in this area (Kallas 2011; Gupta *et al.* 2015). On the other hand, multiple organisations are involved in developing a platform (roads and railways) and most of the times there is a conflict between them regarding financing the projects especially in low income developing countries (Gurara *et al.* 2017). Updating and upgrading cargo handling equipment is another challenge in infrastructural development in the logistics chain. Moreover, proper cargo handling equipment is needed to accommodate different types of vessels arriving at the port area (Park & De 2015). This includes different types of cranes (unloaders), hoppers, belt conveyors, lifting gear, pallets, crates, fork-lift trucks, van carrier transtainers, transit sheds and different types of warehouses in the port hinterland (Park & De 2015). Outside of the seaport hinterland, there are other transport facilities and platforms to convey cargo to final customers such as railways, air freight transport companies, trucking companies, dry ports, cross-docks, logistics service providers and other partners in the port logistics chain. In addition, information and communication technologies such as Big Data, the Internet of Things (IoT), artificial intelligence, block chains and cloud computing are essential in integrating the activities in the logistics chain (Heilig & Voß 2017). Furthermore, the lack of comprehensive and strategic planning is one of the important challenges in the Iranian port logistics system (Kiajouri & Barimani 2018). In addition, most of the expert are complaining about the separate planning and decisions of different logistics chain partners. It might have overlaps with each other and on some points, they can be in opposite directions which can lead to inefficiency in developing infrastructure and strategic plans (Moradinasab Bahri 2018).

The recent competitive environment in seaports challenged the traditional role of port authorities and the way of governing the seaports (Verhoeven 2009). Some researchers still believed that government and public sector should more actively participate as a market player in the seaports or its role should be limited to correctly imposing the regulations (Meersman & Van de Voorde 2010). Verhoeven (2009) believes that the port authorities role in the logistics context is depending on the governance model and requirements of port management which can be upstream or downstream. He also suggested that the role of port authorities could focus on coordination problems or joint action to decrease bottlenecks in the logistics chain rather than directly interfering to cargo flow activities (Van Der Horst & De Langen 2008). This issue can be more challenging in counties such as Iran which is directly depending on government support. Although in recent years the government's role has been limited, changing the role of government as an operator to a supervisor is one of the important challenges. On the other hand, providing a secure environment for ship-owners and shipping agents is one of the barriers in port governance especially in unsecured areas such as the middle east (Valleri 2005).

Marine transportation is going to be more important in international trade and highly competitive markets in developing countries due to its impact on the final price of imported and exported products. In such condition, any delay in the cycle of marine transportation of goods can lead to unnecessary costs and consequently the removal of many actors in the import and export sector. In this cycle, efficient physical distribution in the port logistics chain is one of the basic requirements. These requirements can be complicated by increasing the competition between different seaports in the region such as Jebel Ali port in UAE, Salalah port in Oman and Shahid Rajaei port in Iran (Elbayoumi & Dawood 2016). According to the statistics, the rate of efficiency in neighbouring countries ports is significantly higher than Iranian seaports. Kazemi *et al.* (2011) investigated the affecting factors to cargo clearance in Iranian ports. The results show that improving the logistics and transportation system, customs clearance performance and the role of consignees in customs clearance are important factors. Improve licence for cargo releasing, decrease bureaucracy, improve technical infrastructure, update information systems and political and geographic issues are other important factors in customs clearance in Iranian seaports.

Although organisational interaction and management practices are not directly involved in the port logistics chain, the relevant literature recognises that inter-organisational issues are crucial in logistics chain efficiency and few researchers have addressed them in port integration and hinterland transportation studies (Van Der Horst & De Langen 2008). In other words, the amount of collaborating and communicating mechanism in the system (organisation) will show its overall competitiveness and efficiency (Childerhouse *et al.* 2011). In the port logistics context, there are different barrios such as rigid regulations, lack of skilled human resources, poor customer relationship management to attract customers and lack integrated supply chain thinking and strategies (specifically in top managers and policy makers) between logistics organisations, which make the relationships complex (Ghaderi *et al.* 2017). The rigidity of laws and regulations will increase excessive bureaucracy and ambiguity between different logistics chain partners which increase the waiting time, delivery time and eventually final price of the cargos. Moreover, lack of skilled human resources has been identified as one of the key influential factors on logistics and supply chain competencies which can alter the way of thinking and planning the procedures and setting strategic plans to improve logistics chain integration (Ding *et al.* 2015).

Finally, using smart technologies and becoming smart ports represents one of the recent challenges facing seaports. Modern ports are increasingly using smart technologies such as artificial intelligence, the Internet of Things (IoT) and Big Data to develop their technologies and, in turn, enhance port efficiency. One of the big differences among different seaports is using smart technologies to develop the logistics processes (Alix 2017). However, a comparison of ports' use of technology is complicated given that different ports in a different parts of the world use various types of smart technologies. Rating the ports by their technology requires an independent study (United Nations 2016). Nevertheless, the current study has reviewed some technologies in developed countries and compared their usage in developing countries. For instance, Cisco technology has been used in a Hamburg port to monitor traffic, anticipate the lifting of a bridge or clearing of a road after an accident, and control the movement of barges when the traffic is congested using sensors, smart lights and camera systems (Alix 2017). Another example relates to the use of IoT in developed ports in China and Germany where all devices are connected via the so-called IoT to provide crucial services in a faster and more efficient manner. In order to transform the port to "smart" ports, different drivers and sensors are instrumental such as inertial sensors, ultrasonic sensors, eddy current sensors, radar, lidar, imaging sensors, and RFID readers and tags (Yang *et al.* 2018). However, the word "smart" does not always mean using new technologies; the intelligence of a port is also based on its ability to develop a collaborative approach to becoming more attractive and competitive (Alix 2017).

## 2.9. SUMMARY

This chapter reviews the existing literature on port logistics integration, including the evolution of the relevant concepts, approaches, influential factors and impacts of logistics integration in the seaport sector. It has been found that logistics integration is critical to the operational efficiency of ports as nodes of a broader transport and logistics system. In general, there are three main views of logistics integration: internal-external view, actors view and logistics integration activities and functions. Besides a port's main activities (such as cargo handling operations and information sharing), its logistics integration typically involves infrastructure and resources, especially organisational integration, institutional support and resource integration which has been rarely mentioned in port logistics integration studies.

Port logistics integration is complex with a wide range of factors, activities and perspectives. Information integration has been addressed in different ways such as through the information and communication system (Panayides & Song 2008), use of information and communication technology (Song & Panayides 2008), integration of flow of integration (Fabbe-Costes & Jahre 2008a), integration of technologies and systems (Song & Panayides 2008) and internal-external integration (Prajogo *et al.* 2015). Process and operations integration has overlapped with the concepts of integration of transport modes, relationship with inland transport operators and multimodal systems and operations, and integration of physical flow and actor's integrations. Value-added services and logistics practices were identified as two important factors in the port logistics area of study, both of which can have a dominant impact on logistics integration.

Overall, the review results suggest that a comprehensive framework is needed to consider not only activities and functions in the port logistics chain but also logistics chain partners. In addition, it is essential to also consider the challenges as well as the success factors that provide a valuable, realistic view in port logistics integration and recommendations for port management and stakeholders.

# CHAPTER 3: ORGANISATION AND OPERATIONS OF IRANIAN SEAPORTS

## 3.1. INTRODUCTION

Iran is the world's 18th most-populated country, home to more than 81 million people. It is the second largest country in the Middle East and endowed with energy resources of 10 percent and 15 percent of the world's oil and gas reserves respectively, rendering it one of the top five energy superpowers (Craig 2016). Iranian trade with the rest of the world accounts for about 46 percent of its GDP and comprises mainly oil and gas exports of 80 percent of the total export value in 2017 (WorldBank 2018).

Similar to seaports in other countries, Iranian seaports are considered commercial, historical and infrastructural assets which form the backbone of the national economy and international trade. They carry out a range of services and activities in three main areas; namely, administrative functions, operational functions and civil engineering functions (Alderton and Saieva (2013). The administrative function focuses on port commuting control, environmental control, safety and security, dangerous goods as well as health and customs control. Operational functions include freight and logistics services for maritime trade (such as cargo loading, discharging, storage and distribution, pilotage, pilotage, tugging, and mooring activities). The civil engineering function encompasses infrastructure development, sea and land access, the road and rail network, and industrial area management. Alternatively, their services can be divided into three main activities and functions; in particular, marine services (nautical infrastructure), terminal services (quay and berth infrastructure), and logistics and value-added services (port superstructure) (Bichou 2014). Container transhipment in Iranian seaports is mostly handled by 18 international companies. Around 50 percent of this transhipment is handled by the Islamic Republic of Iran Shipping Lines (IRISL) (which is owned by the Iranian government) through ports in north (Caspian Sea) and south parts of Iran (Persian Gulf and Oman Sea) (Tinnews 2018).

Due to the country's reliance on international trade, the port sector is expected to play an active role in the country's future freight and logistics system. This chapter presents background information about the port sector in Iran and its challenges – especially those that are associated with its logistics integration. Section 3.2 provides the trends in the Iranian economy and maritime trade. Section 3.3 reviews the Iranian (sea) port sector in terms of the organisation, policy, performance and related issues. Section 3.4

presents the sector's operational performance and challenges, and Section 3.5 is a summary.

## 3.2. IRANIAN ECONOMY AND MARITIME TRADE

### 3.2.1. Overview of the Iranian economy

The Iranian economy is a transitional economy dominated by the public sector representing about 60 percent of national output. A large share of the country's export value (around 80 percent) comes from the oil and gas sector, which accounts for approximately 60 percent of the government's revenue (Economist 2003). Iran's economy has three major sectors: agriculture, services and manufacturing. The Iranian government directly owns and runs hundreds of firms and indirectly controls many companies in different provinces. Since 1989, the government have planned and executed plans for long-term economic growth, including one for the transport and logistics sector. As more than 90 percent of trade is carried by ships, investment in the maritime sector irrefutably contributes to the country's economic growth and development (Moradi & Ghasemi 2013). Due to the impact of maritime transportation on the Iranian economy, logistics is considered an important economic-service sector (WorldBank 2018). The Iranian shipping industry owns around 229 ships which are 1.1% of the total global fleet capacity. However, maritime transportation is mostly active in bulk and general cargo rather than container shipping. The world's annual shipping revenue in terms of shipping fare is $388 billion, which is 5 percent of the global trade volume. Therefore, maritime logistics and container shipping will have a huge impact on Iran's economy (YJC 2018).

### 3.2.2. The effects of international sanctions

According to Yousefi (2015), one of the biggest challenges facing the Iranian economy relates to the sanctions imposed on the country. That is, sanctions continue to have severe impacts on Iran's international trade and maritime transport sector. U.S. sanctions have targeted the Iranian economy in different ways. For instance, the sanctions have imposed extensive restrictions on the banking sector and its relations with the international system and international transactions (Kozhanov 2011). Hence, there is an unwillingness of financial institutions and credit institutions to invest in the Iranian economy. Furthermore, due to the lack of low-cost banking facilities through the international banking system, for some goods, the shipping costs are equal to its actual price (SCI 2015). As a result, many financial institutions, insurers and logistics companies are restricted from trading, investing and conducting other kinds of business with Iran. These sanctions put pressure on Iran's banking system, increasing the costs, risks and trade diversions of companies.

Most sanctions against Iran, especially its shipping operations, were imposed in 2006, eased through a Joint Comprehensive Plan of Action (JCPOA) in 2015, but then fully reinstated in 2018. Given the resumption of the sanctions, the country's maritime transport will again face serious challenges (Sayareh 2018) as they do not allow Iranian registered ships to call at other international ports. Hence, Iranian vessels have had to change their flags of registration. This has caused the transport costs for finished goods to double the global average (Pazoki 2010). Moreover, fuel costs comprise 30 percent of a vessel's operating costs. With the sharp decline in freight rates and revenue and the rise in fuel prices, shipping companies' profit margins have been severely adversely affected.

### 3.2.3. Maritime trade

Maritime transport plays an essential role in Iran's international trade. In 2017, the volume of loading and unloading of goods by ships was above 153 million tonnes (including 36 percent bulk cargo, 13 percent general, 33 percent petroleum and 18 percent containerised cargo). Table 3.1 indicates incoming and outgoing cargo throughput over the 2015-2017 period. This volume increased by 4.2 percent in 2016 and by 7.9 percent in 2017 after signing the JCPOA agreement (PMO 2017). Shipping lines are one of the most important parts of the logistics chain in the port logistics system. The Islamic Republic of Iran Shipping Lines (IRISL) is the largest shipping line company in Iran. IRISL was established in 1967 and commenced its commercial operations by employing two home trade vessels and four larger ocean-going vessels. Operational services carried out using a container in the form of six lines and 24 ships with a nominal capacity of 91,000 TEU (IRISL 2016).

Table 3.1. Incoming and outgoing cargo throughput 2015-2017

| | 2017 | % | 2016 | % | 2015 |
|---|---|---|---|---|---|
| Essential Goods | 17,392,272 | -0.1 | 17,413,522 | -9.6 | 19,264,020 |
| Metal Goods | 9,616,017 | -0.6 | 9,670,343 | 0.7 | 9,604,617 |
| Construction And Mineral Goods | 34,477,850 | 13.4 | 30,415,168 | 17.3 | 25,929,377 |
| Automobils And Some Parts | 650,253 | 2.5 | 634,186 | -16.4 | 758,780 |
| Fertilizers And Chemicals | 5,506,943 | 46.8 | 3,751,166 | -8.7 | 4,108,351 |
| Clothes Paper And Wood | 1,307,689 | 3.9 | 1,259,097 | 3.3 | 1,218,375 |
| Miscellaneous | 6,789,837 | -1.8 | 6,913,477 | -19.4 | 8,572,900 |
| Containerized Cargo | 30,377,740 | 24.5 | 24,406,932 | 10.8 | 22,034,331 |
| Oil Products | 46,916,917 | -0.8 | 47,305,552 | 6.1 | 44,565,771 |
| Other | 0 | 0.0 | 0 | -100.0 | 14 |
| **Total** | **153,035,519** | **7.9** | **141,769,441** | **4.2** | **136,056,537** |

Source: PMO (2017)

Despite a great need for freight and logistics services, there is a limited number of logistics service providers in Iran with key providers in DHL Supply Chain & Global Forwarding Company, TNT and FedEx Supply Chain/FedEx Trade Networks. Third-Party Logistics (3PL) companies work in a wide range of activities such as transportation, warehousing and storage, as well as packaging and distribution. These companies can have a significant impact on increasing the efficiency of businesses by reducing logistics costs and increasing the level of service to customers and consumers as well as reforming the distribution system of the country (Fahollah 2018).

Generally, cargo handling is undertaken by road, rail and air. Road transportation is the most important transport mode in Iran, approximating 80 to 85 percent of all cargo transfer in the country. Road freight provides several advantages over other modes of transportation such as cost-effectiveness, quick and scheduled delivery, local, over border, long or short haul deliveries even in rural areas and flexible service (Logisticscluster 2015; Frighthub 2018). Except for a very small percentage of transportation by airway, almost all the logistics processes in Iran are conducted by the rail and road sectors. A report by the International Transport Companies Association of Iran shows that there are over 300 companies that are cooperating with seaports in cargos transportation to final customers (ITCA 2016).

Approximately 33 million tonnes of merchandise and 29 million passengers are conveyed by the railway system every year, around 17 percent of the transport cargo volume in Iran (PMO 2016b). Due to Iran’s ideal geographical location, some of the more important ports, such as Imam Khomeini and Shahid Rajaee, have been developed with railway access. The government plans to expand the rail system by 500 kilometres per year to transport over 3.5 percent of passengers and 8.5 percent of goods. According to the strategic plan, Iran's total rail track will reach 25,000 kilometres by the end of 2025 (MRUD 2016). The rail transport system contains 11 companies working under the management of the Islamic Republic of Iran Railways Company. The pricing of transport and related services are regulated by the Ministry of Road and Urban Development (RAI 2014). As shown in Figure 3.1, from 11 commercial ports in Iran, only four are connected to the railway system, namely Imam Khomeini, Khorramshahr and Shahid Rajaee ports in the south part of Iran and Amirabad port in the north (Solimani 2012). Together, these ports handle more than 80 percent of the country's maritime trade (PMO 2017).

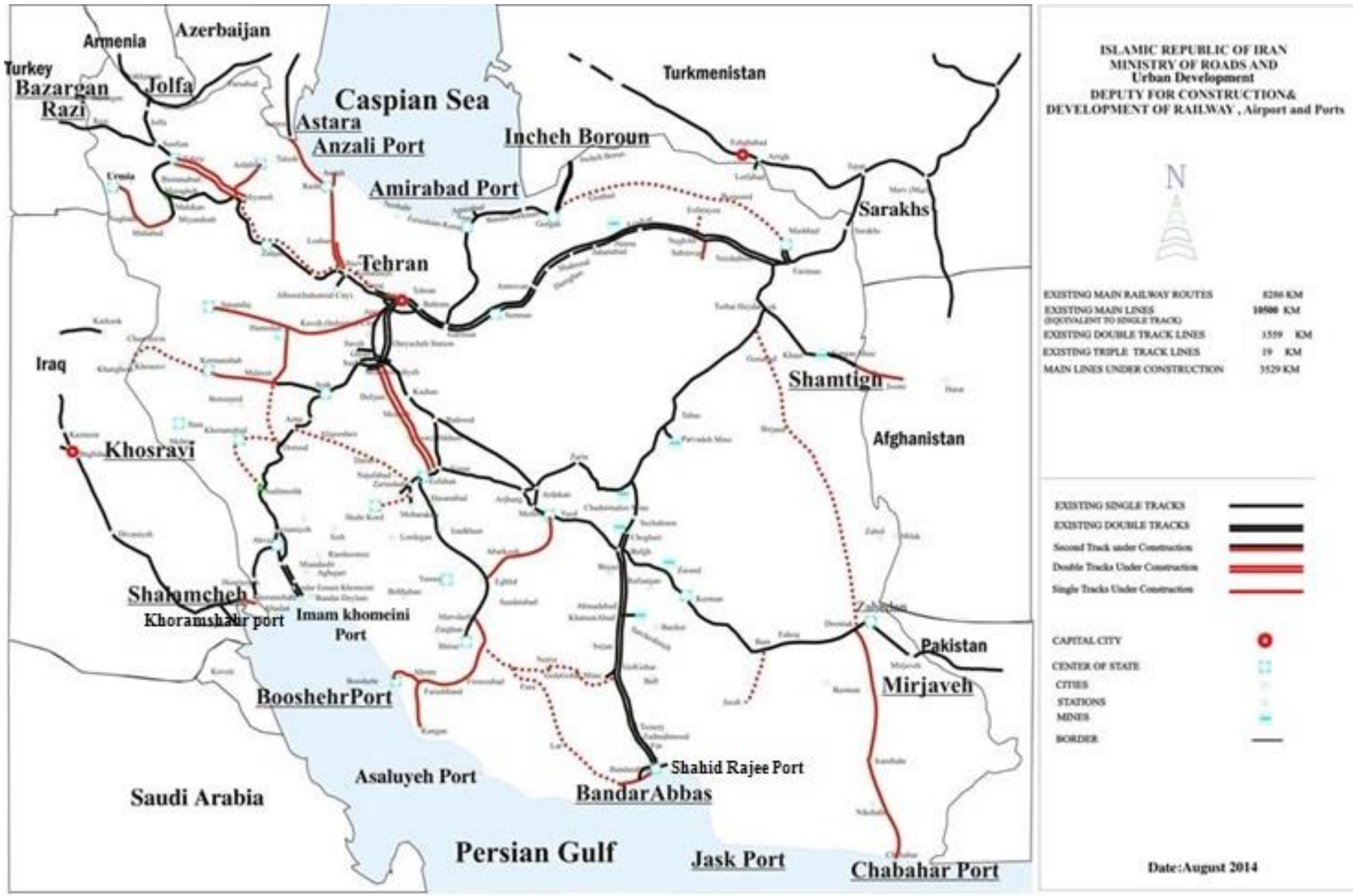



Figure 3.1. Iranian railway network
Source: IranRailway (2016)

### 3.3. ORGANISATION OF THE PORT SECTOR

Iran ports are located in a strategic region with access to the Oman Sea and the Persian Gulf in the south, and the Caspian Sea in the north. All commercial seaports in Iran are owned by the Iranian Ports and Maritime Organisation (PMO). PMO is responsible for the regulation of the port sector. It also has the authority to grant concession to private operators to provide commercial services within the ports (Sayareh 2006). Therefore, all Iranian seaports are subject to PMO's same regulatory and management system that covers:

- Managing port and maritime affairs commerce
- Creating, developing and completing port and maritime buildings and facilities and repair shops
- Formulating and implementing port and maritime trade rules under the applicable law
- The loading and unloading of cargo and storage facilities in the ports
- Telecommunications networks management (radio - telegraph, telephone, teletype, etc.) at land and seaports in order to track the ships
- Establishing signs and lighting on sea and river vessels for traffic safety
- Granting certificates of technical competence, marine and other relevant provisions
- Determining the use and utilisation rate of the seaport's facilities and equipment
- Research and study in the port and maritime sector
- Drawing up and implementing annual and long-term plans
- Planning international agreements and contracts related to ports and maritime affairs
- Membership in relevant international organisations and participation in international conferences and forums
- Acquisition and management of railway lines and wagon management, their related equipment and other necessary equipment for loading and unloading supplies for indoor and outdoor warehouses
- Establishing training schools for commercial maritime staff

- Setting lower interest rates in cargo transportation to Iranian ports, expediting the loading and unloading of equipment and eliminating waiting time for ships (PMO 2016a)

As detailed below, the port sector comprises of 6 main ports and the following paragraphs will review different characteristics of these 6 ports.

### 3.3.1. Shahid Rajaee Port

The Port of Shahid Rajaee is located 1500 kilometres from Tehran, and 23 kilometres from the Persian Gulf. It has 4800 hectares of land and handles 89 million tonnes of cargo each year on average, including 3 million TEUs of containerised cargo. The Port of Shahid Rajaee has 23 berths at average depths of 15 meters. The terminal number one includes 850 meters of berths with a depth of 17 meters and 70 hectares of the yard, able to accept as large as 7th generation container ships. The Port of Shahid Rajaee maintains over 19 hectares of roofed warehouses and 23.5 kilometres of domestic railway tracks. Another 16 kilometres of the railway is under construction.

This port is Iran's largest port, supporting maritime trade with more than 80 ports worldwide due to its many advantages including:

- Access to the ocean and international trade zone;
- Location on the main routes of transit corridors North - South and East - West to facilitate the transportation of goods to Central Asia, the area of the Persian Gulf, Sea of Oman, Afghanistan, Pakistan and Iraq;
- Adjacency to the main production centres and industrial hubs;
- Links to rail and road with Central Asian countries, Russia and Northern Europe;
- Access to the direct railway, loading and unloading equipment and modern facilities;
- Access to dedicated transit fuel container terminals, petroleum products and minerals (PMO 2015).

Despite the above advantages, the main limitation of the port is its long container vessel turnaround time that decreases its competitiveness compared with its neighbouring ports (Eskandari *et al.* 2013; PMO 2015).

### 3.3.2. Imam Khomeini Port

Imam Khomeini Port (IKP) is Iran's biggest bulk cargo commercial port, located in the Khuzestan province which is 65 kilometres from the entrance of the Khore Musa estuary and only 18 kilometres from the nearest airport. This port is connected to the Persian Gulf and Oman Sea. It has the highest record of loading and unloading productivity among all Iranian ports, handling hundreds of commercial vessels each year and becoming one of the busiest marine areas in the world. However, due to contributory factors within its geographical situation, the port has accumulated high-levels of petroleum and metal source. Such factors include the accelerated development of urbanisation, industrialisation and dense port activities in the area, the placement of the cities of Mahshahr and Sarbandar near the port, and the existence of a massive petrochemical industry (Abdollahi *et al.* 2013).

Imam Khomeini Port (IKP) is known for many advantages including:

- Relationship with the main transit road network and railroad
- Proximity to the largest Special Economic Zone Industry and petrochemical complexes
- Located on the transit route of goods from Southeast East and Iraq, Turkey and Central Asia
- Capable of receiving ships of 150,000 tonnes
- Benefits from dedicated cereals terminals and Iranian's largest cereal terminal
- The possibility of direct transportation of goods by ship to major commercial and industrial centres in the country (PMO 2015)

### 3.3.3. Bushehr Port

The Bushehr province has a unique position with a 700-kilometre water border with the Gulf states and its proximity to the open sea. The total area of the hinterland is 126.65 square kilometres, and its cargo handling capacity is 8 million tonnes per year. Bushehr port has two berths with depths of 9.5 meters (Bushehrport 2015). Bushehr port is the main port for liquid bulk exports including petroleum derivatives and chemicals. Notably, fruit traffic has become a competitive advantage for the Bushehr port since accepting reefer ships for the last decade. Completed in 2008, Bushehr port was one of the largest development projects for an Iranian port, increasing its port from about 2.7 million tonnes to more than 5 million tonnes per year (Abolhassani 2010; Rastad 2012).

Bushehr port's capability and advantages include:

- 20 percent discount on entry rights, the cost of freight, warehousing, THC exports, and duties on vessels carrying cabotage goods.
- 20 percent discount to a commercial benefit.
- Proximity to Industrial Special Economic Zone and supporting appropriate capacity for carrying cargos, containers and vehicles.
- The shortest distance to the production and consumption centres in Fars, Isfahan and Kohgiluyeh Boyer Ahmad provinces.
- Closest southern port to the countries of the Persian Gulf (Qatar, Bahrain and Saudi Arabia).
- Shipbuilding and offshore capabilities and the possibility to support ships.
- Close to the largest oil export terminal at Kharg Island.
- Close to the port of Assaluyeh as the hub of the country's energy.
- Largest Terminal for importing and exporting fruit and special cold storage for preserving fruit (PMO 2015).

### 3.3.4. Chabahar Port

Chabahar port is located in the southeast of Iran, on the northern coast of the Gulf of Oman. As Chabahar is located closest to Afghanistan and Middle Asia, it is considered one of the most cost-effective and efficient routes for international shipping, and the best and only viable option in developing Iran's eastern provinces, Sistan and Baluchestan. Implementing the first phase of the Shahid Beheshti development program with a fund of 350 million USD, and a nominal loading and discharging capacity of 6 million tonnes per year lay the foundation of a bright future for the port (Chabaharport 2015). India signed a deal with Iran entailing 85 million USD investment in Chabahar port and industries in Chabahar Special Economic Zone in 2016. Following this agreement, a huge development is expected for Chabahar port (PMO 2018).

Capabilities and advantages of this port include:

- 30 percent discount on all tiers of port duties for entering container ships.
- At least 30 percent discount for the cost of loading and unloading containers.

- 75 percent discount on storage of imported containers and 85 percent discount on exported containers.
- 30 percent discount on the cost of freight and warehousing on non-containerised goods compared to other ports.
- Integrated management system (IMS) certificate holder.
- Incoming international gateway corridor (north-south and east of the country) (PMO 2015)

### 3.3.5. Anzali Port

Anzali port is considered the most important and most strategic port among Iranian northern ports due to its role in raw materials supply to major factories in the past ten years (Maleki *et al.* 2015). Anzali port is attractive to shipping lines for two main reasons: the natural conditions of the Gulf of Anzali and Anzali canal and the geographical proximity to the commercial centres of Guilan (AnzaliPort 2015). Other capabilities and advantages of this port include:

- Located on the North-South International Corridor route
- Located in the Anzali Free Trade-Industrial Zone, providing legal facilities for owners and merchants for investment through tax exemptions
- Close to the largest oil and gas reserves of the Caspian Sea
- Access to lead, zinc and iron mines and industrial centres (PMO 2015)

### 3.3.6. Amirabad Port

Amirabad port and its Free Trade-economic Zones are located in the northeast of the Mazandaran province with a total land area of 61 square kilometres. Construction of the port went underway in 1997 and 1998 due to its privileged position (Amirabadport 2016). The strategic location, anticipated number of berths, railroad grid connection, construction of oil refineries, and breadth of supported sites are the main advantages of the area which render it as a fundamental port in the north and a strategic port for exchange of goods between the Islamic Republic of Iran, the Caspian Sea and Central Asia and Caucasus countries (Iranfreezone 2016).

Capabilities and advantages of this port include:

- Easy access to a market of 300 million people in the CIS countries.
- Located in international road corridor north-south direction.

- Capability to facilitate the transit of cargos from Scandinavia and the Caucasus to the area of the Persian Gulf, Turkey, Iraq, Afghanistan and Pakistan.
- The possibility of investment in the steel industry, pulp and paper, mineral materials, interfaces, dairy products, fuel, construction tanks, silos, and grain.
- Close to oil port, oil terminals and Sari International Airport.
- Using a modern multi-modal transport infrastructure, Ro-Ro docks with rail and trucks.
- Access to grain silos with a capacity of 120,000 tonnes, rising to around 450,000 tonnes (PMO 2015).

Next section reviews different characteristics of six major seaports in Iran. Figure 3.2 indicates the location of the six major commercial seaports mentioned above. These seaports handle around 91 percent of the country's trade in terms of loading and unloading volume, imports and exports, and transit of oil and non-oil cargoes. Their contribution to the development of the country is considered to be highly significant. Table 3.2 presents key information regarding 11 key ports in Iran including distance from the provincial centre, the capital city Tehran, nearest airport, channel length and basin depth.

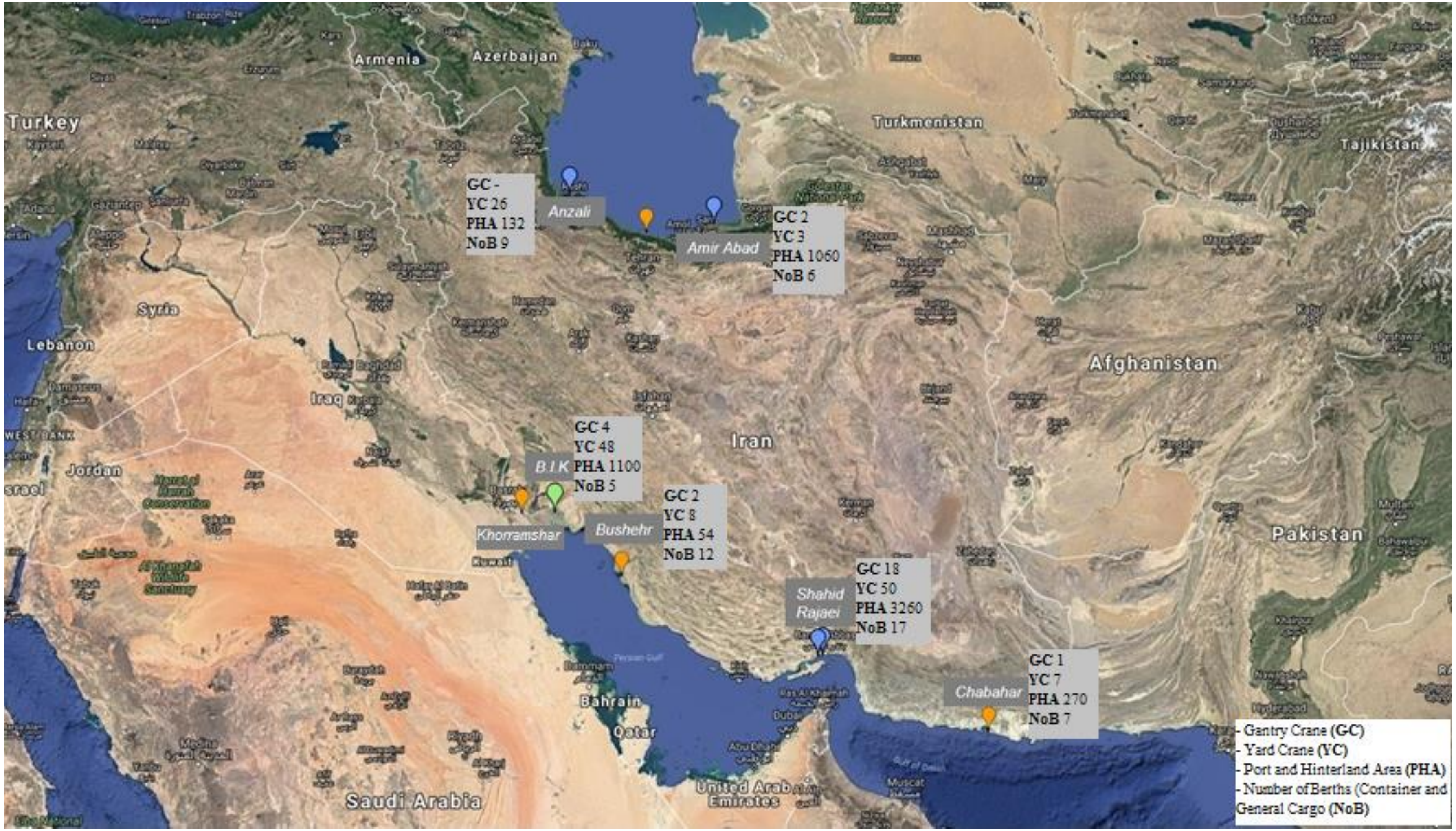



Figure 3.2. location of Iran's Major Seaports

Table 3.2. Summary of basic information for Iranian ports

| Title | Province | City | Distance from Province Centre | Distance from Tehran | Distance from Airport | Channel Length | Basin Depth | Berth Length | Gantry Crane | Yard Crane | Number of Berths (Container and General Cargo) | Port and Hinterland Area | Open Storage Area | Warehouse Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shahid Rajaee** | Hormozgan | Bandar Abbas | 32 | 1350 | 40 | 8334 | -14 | 8245 | 18 | 50 | 17 | 3260 | 1999979 | 462069 |
| **Imam Khomeini** | Khuzestan | Mahshahr | 100 | 1000 | 18 | 111120 | -14 | 7765 | 4 | 48 | 5 | 1100 | 710000 | 250000 |
| **Amir Abad** | Mazandaran | Neka | 60 | 300 | 50 | 987 | -6 | 1800 | 2 | 3 | 6 | 1060 | 106482 | 62642 |
| **Bushehr** | Bushehr | Bushehr | - | 1100 | 3 | 15000 | -6 | 2272 | 2 | 8 | 12 | 54 | 186369 | 31061 |
| **Noshahr** | Mazandaran | Noshahr | 180 | 215 | 3 | 1852 | -5 | 1430 | - | 23 | 7 | 44.1 | 40527 | 30495 |
| **Anzali** | Gilan | Bandar Anzali | 40 | 365 | 35 | 3000 | -5 | 1578 | - | 26 | 9 | 132 | 168861 | 53054 |
| **Chabahar (Shahid Beheshti)** | Sistan and Baluchestan | Chabahar | 670 | 1961 | 40 | 2788 | -12 | 1280 | 1 | 7 | 7 | 270 | 110231 | 37863 |
| **Khoramshahr** | Khuzestan | Khoramshahr | 125 | 997 | 15 | 116676 | - | 2471 | 2 | 7 | 12 | 230 | 225462 | 126056 |
| **Lengeh** | Hormozgan | Bandar Lengeh | 185 | 1700 | 6 | - | -5.5 | 475 | 0 | - | 2 | 20.5 | 74850 | 6400 |
| **Bahonar** | Hormozgan | Bandar Abbas | - | 1500 | 17 | - | -10.5 | 1447 | 0 | - | 5 | 15.8 | 18789 | 30701 |
| **Abadan** | Khuzestan | Abadan | 120 | 1000 | 5 | - | -5.5 | 416 | 0 | - | 3 | 6.5 | 11907 | 7254 |

Source: (PMO 2016a)

### 3.4. Operational performance and challenges of the port sector

Cargo handling productivity or ship turnaround time is one of the most important indicators of a port, due to the daily operating cost of 10,000 USD for a container vessel[1]. Yet, cargo handling facilities and container logistics operations management collectively represent a primary challenge facing Iranian seaports (Alsafi 2009). According to a Donya-e-eqtesad (2016), the cargo handling efficiency in Iranian seaports has been decreasing for the second consecutive year, down by 10.5 percent in 2014 to 14.6 percent in 2015; reaching 8.6 million tonnes with a 13 percent decrease in comparison with the last year. Despite annual cargo, throughput was planned to reach 50 million tonnes by the end of 2016; this target is yet to be fulfilled. According to a report by Shahid Rajaee port, Iran's biggest container port, their performance fell by 15 percent in comparison with its previous year. Similarly, Imam Khomeini port's performance went down by 12 percent in 2016 (Donya-e-eqtesad 2016).

According to reports by Donya-e-eqtesad (2016), the price of oil has been the main factor ports influential to port throughput; declines in oil prices that directly affect imports and demand for port services. In 2016, the non-oil and oil cargo volume decreased by 20.7 percent and 4 percent accordingly. As mentioned earlier, international economic and political sanctions are among the contributing factors in declining port performance (Seanews 2016). In addition, low efficiency compared to the world's leading ports is the main challenge facing Iranian seaports. For example, because of the long vessel turnaround time in Shahid Rajaee port, port charge increased to over 50,000 USD per ship (Keshavarz 2014).

The review of the literature indicates that different factors have been used in order to measure container port performance. Most of the analysis has been carried out by shipping companies and port authorities using different proprietary measures and time-scales to produce their statistical data (Chen *et al* 2016; Paixão and Bernard Marlow 2003). Measurement indicators in container ports are related to shipping traffic, container throughput, berth utilisation, terminal productivity, the number of container ships arriving at terminals and the number of containers handled by terminal facilities (Steenken *et al* 2004; Murty *et al* 2005; Fourgeaud 2000; Kemme 2013; Chen *et al* 2016). A recent study on the logistics performance of Chabahar port listed the

[1] The actual amount varies with ship size, type and age.

most challenging factors including access to terminals, terminal equipment, the rate of loading and unloading and status notification of quays (Sayareh & Fooladi Mehtarkalateh 2016). Moreover, Iranian seaports —specifically Shahid Rajaee— have lower productivity compared to other ports in the neighbouring region. The type of subsystem available in the port, the kind of decision and the time period of decisions are the biggest challenges facing Shahid Rajaee port. Port subsystems refer to different stages in the logistics system such as ship to shore (unloading a container from the ship to the berth and vice versa), transfer (where containers are transferred from the berth to the storage area or vice versa), storage (storage and holding container systems in the existing blocks) and delivery/ receipt (common intersection among internal, road and railroad systems) (Azimi & Ghanbari 2011). On the land side, truck congestion is one of the key issues in port efficiency and performance. For example, Shahid Rajaee port has an average truck turnaround time of about 11 hours.

This highlights the need to improve ports' connectivity and integration with the inland transport and logistics system as well as the ports' terminal allocating system at gates, cargo handling in container yards, documentation, transaction and information management (Sadeghifar & Amiri Farsi 2011).

### 3.5. SUMMARY

This chapter provides background information on the Iranian maritime trade and seaport sector including its organisation and operations. Iran is one of the largest economies in the Middle East with its maritime trade of around 1.5 percent of the world's total and 90 percent of this being carried by sea. Recently, the economy has experienced various economic downturns. GDP decreased by 160 billion USD over the three-year period of the intensification of the economic and political sanctions (2011-2014). Economic and political sanctions were imposed again in 2018 and will likely directly impact its maritime trade and shipping.

There are six major seaports in Iran all owned and operated by the PMO. Despite ports' important role in international trade and economic development, Iranian port performance is subject to a number of challenges in terms of integration with the inland transport and logistics system, infrastructure, cargo handling facilities, management and policy. While the impact of the sanctions on the economy and shipping is hardly unnoticed, ports should continue to harness the many advantages they have, such as their strategic location and access to the hinterland.

# CHAPTER 4: RESEARCH METHODOLOGY

## 4.1. INTRODUCTION

The methodology of the research is one of the most important steps of the research as the research findings highly depend upon the methodology adopted (Bandara 2015). The previous chapters described the background of the research questions and the literature on port logistics integration. The literature review in Chapter 2 reveals the lack of studies in port logistics integration such as organisational activities, resource sharing and institutional support, which are critical in integrating logistics activities. Chapter 3 examines logistics infrastructure in Iranian seaports and its challenges and opportunities in particular. The literature review shows that no practical study has investigated logistics integration activities in the Iranian context, which is the research gap the current study aims to fill. Based on the literature, this chapter proposes a conceptual framework and develop a survey questionnaire as the main data collection instrument for the analysis of port logistics integration factors. The survey aims to answer the secondary research question one, which is related to the influential factors of port logistics integration, and secondary research question two, which limits it to the Iranian context. Factor analysis will be applied to identify and analyse the underlying factors in port logistics integration in Chapter 5. Furthermore, open-ended questions will be used to answer secondary research question three on the challenges of port logistics integration. Following the research questions, a conceptual framework concerning the influential factors of port logistics integration is proposed based on literature on logistics integration studies. The research design encompasses data collection, questionnaire design and data analysis methods which will be explained in depth in this chapter.

The chapter is structured as follows: Section 4.2 discusses the research philosophy and the main dimensions of the study; Section 4.3 proposes a conceptual framework of the study and its factors and relationships; Section 4.4 concerns the questionnaire design; Section 4.5 reviews the questionnaire design process; Section 4.6 focuses on research design and procedures for data collection; Section 4.7 explains the validity and reliability of the research method; Section 4.8 explains the data analysis method; Section 4.9 discusses research ethics; and finally, Section 4.10 provides the chapter summary and conclusions.

## 4.2. RESEARCH PHILOSOPHY

Research philosophy can be defined as the guiding principles that inform the way a research project is conducted, i.e. examining the phenomena with a chief interest in the foundation, nature and expansion of knowledge (Saunders *et al.* 2009; Bajpai 2011). It reflects the views and expectations of the research project. It helps researchers to choose a suitable approach among alternatives (Johnson & Clark 2006). As shown by Saunders *et al.* (2009), Figure 4.1 shows how research philosophy informs the data collection and analysis of a research project through the different 'layers' including the approaches, methods, types of analysis and data.

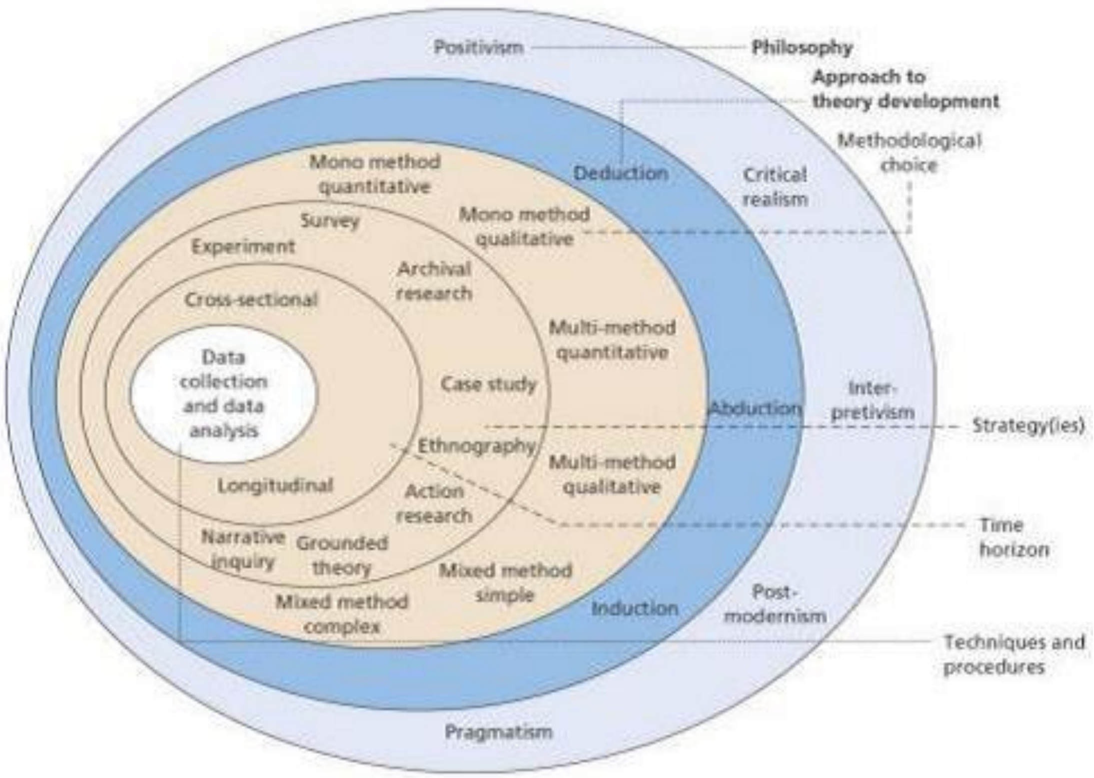



Figure 4.1. Main dimensions of the study
(Source: Saunders *et al.* (2012))

Saunders *et al.* (2009) introduce four research philosophies: positivism, realism, interpretivism and pragmatism. Positivism is a philosophical system, which can be scientifically verified, or a mathematical proof to which positivist scholars are expected to apply a profoundly organised methodology to enable replication (Saunders *et al.* 2009; Gill & Johnson 2010). Realism is a philosophical position related to the scientific enquiry, which is highly inspired by 'Objectivism'. There are two approaches to realism: ontological/ metaphysical and the epistemological approach. Ontological/ metaphysical realism holds that reality exists independent of the mind and that what a researcher's senses show her or him is the truth; albeit, the researcher is influenced by their own worldviews and experiences (Saunders *et al.* 2009; Gill & Johnson 2010). On the other hand, the epistemological approach reflects that "reality to be cognitively accessible to observers" (Gill & Johnson 2010). Interpretivism philosophy is a social phenomenon in its natural environment. The focus of this philosophy is collecting data from individuals rather than objectives and conducting an assumed attitude to figure out their social world and the sense they give to it from their own perspective (Saunders *et al.* 2009). In pragmatism philosophy, the researcher seeks to find practical consequences. They consider that no single perspective can ever give a comprehensive image and that there may be various realities. This does not necessarily mean that researchers should always examine different methods for a single case; only that the research design should be reliable, credible and relevant to support consequences (Saunders *et al.* 2009). In terms of the philosophy of the study, this research will follow pragmatism philosophy due to the emphasis of the study on mixed method design and the practical considerations of the research purpose and research questions (Sakalayen 2014a).

The second layer in the development of the research project (Figure 4.1) is research approaches, which can be classified into two categories: deductive and inductive (Gulati 2009; Wilson 2014; Babbie 2015). Some researchers may add a third category which is abductive reasoning (approach). In the deductive approach, researchers develop a theory or hypothesis and design a research strategy to test the theory. Based on Robson (2002) deductive research encompasses five stages:

1. Deducting a testable proposition (hypothesis) from theory;
2. Articulating a hypothesis in practical terms and propose a relationship between variables and concepts;
3. Testing the hypothesis using related methods;
4. Analyse the results of the hypothesis testing;
5. Modify the theory based on the results where needed.

In the inductive approach, researchers collect data and design research to develop a theory or remarkable results after the data analysis process. The abductive reasoning typically uses observation to reach the theory and looks for simple and most likely explanations, otherwise known as "inference to the best explanation" (Sober 2013). In some studies, it is hard to differentiate between these three approaches; hence, the study can be a mixture of approaches (Saunders *et al.* 2009). The first part of this study, centring on the quantitative analysis of port logistics integration, will utilise a deductive approach. Namely, this section administers a questionnaire to a large sample group to help answer the second research question. In the second stage, aimed at identifying the challenges of port logistics integration, the study will employ an inductive approach to explain the qualitative part. The qualitative part of the study will be used to gain a better understanding of the challenges in Iranian seaports of which there is currently limited knowledge (Elo & Kyngäs 2008). Thus, the study adopts both methods due to using both quantitative and qualitative data (Saunders *et al.* 2009).

There are three main choices of research methods: quantitative, qualitative and mixed methods (Tashakkori & Teddlie 1998; Teddlie & Tashakkori 2009; Creswell 2013). Denzin and Lincoln (2005, p. 3) defined qualitative research as follows: "…an interpretive naturalistic approach to the world. This means that qualitative researchers study things in their natural settings, attempting to make sense of or interpret phenomena in terms of the meanings people bring to them". In the qualitative approach, researchers search for knowledge which implies an inside perspective to interpret, investigate and understand a particular phenomenon. It is mostly used in case studies where the aim is to receive complete information and thereby obtain a deeper understanding of a problem (Barzi 2009). Qualitative research uses a predefined set of procedures, to collect evidence to answer research questions. What's more, the findings are not predetermined before analysis. The important goal of the qualitative method is exploring phenomena beyond the boundaries of the study (Denzin & Lincoln 2005). Narrative research, phenomenology, ethnographies, grounded theory, case studies and archival research are the possible choices of research design for the qualitative method.

Quantitative research is defined as the systematic practical examination of observable phenomena through mathematical, statistical, or computational methods. (Given 2008). In order to analyse the quantitative data, different forms of statistical and mathematical approaches are used (Malhotra 2008). This method is used in experimental designs, survey research, case studies, action research and similar types of studies (Creswell *et al.* 2011)

As aforementioned, there are some differences between qualitative and quantitative research. Qualitative research uses a subjective approach and tries to investigate social and human behaviour, while the quantitative approach is an objective or practical approach to the research and it looks for techniques to measure and analyse selected components. As mentioned before, the qualitative approach mostly uses texts (transcribes), images, videos and objects (artefacts), whereas the quantitative approach uses numbers and statistics in the form of tables, graphs and diagrams. Common ways of gathering data in the qualitative approach are in-depth interviews, structured and non-structured interviews, open-ended questions, focus groups, narrative content or documentary analysis, participants' observations and archival research. On the other hand, quantitative methods use questionnaires, surveys and other types of determinate data.

The mixed method approach is a general term used when a researcher intends to use both qualitative and qualitative methods in one single study. In this method, qualitative and quantitative data collection and data analysis procedures are used either simultaneously or sequentially, but not a combination of those procedures (Leech & Onwuegbuzie 2009). The advantage of using mixed method is making inference on identifiable qualitative and quantitative data, meaning that the integrated results from both methods will be more coherent and comprehensive than using each one separately (Tashakkori & Creswell 2007; Creswell 2013; Cameron 2015). According to Greene *et al.* (1989), mix method research can be classified into five categories:

- Triangulation; trying to find convergent results.
- Complementarity; exploring interconnected and divergent phases of a phenomenon.
- Initiation; inspecting relationships, contradictions and novel views.
- Expansion; increasing the breadth and scope of a project.
- Development; using different methods together to complement one another (e.g. use interviews to develop a survey).

The development of mix method research can be considered in four periods. The last development is related to post-2000 and named 'advocacy' as a separate design period. This strategy is the most dominant strategy so far (Creswell & Clark 2007; Cameron 2015). Leech and Onwuegbuzie (2009) studied the typology of mix method research, finding that there are different classifications during these four periods (as mentioned above) (Greene *et al.* 1989): theoretical framework (present vs absent) (Greene & Caracelli 1997), time orientation (sequential or concurrent), emphasis of approaches (dominant versus equal) (Morgan 1998), and stage of integration (Tashakkori & Teddlie 1998). Figure 4.2 indicates the different typologies in an integrated diagram.

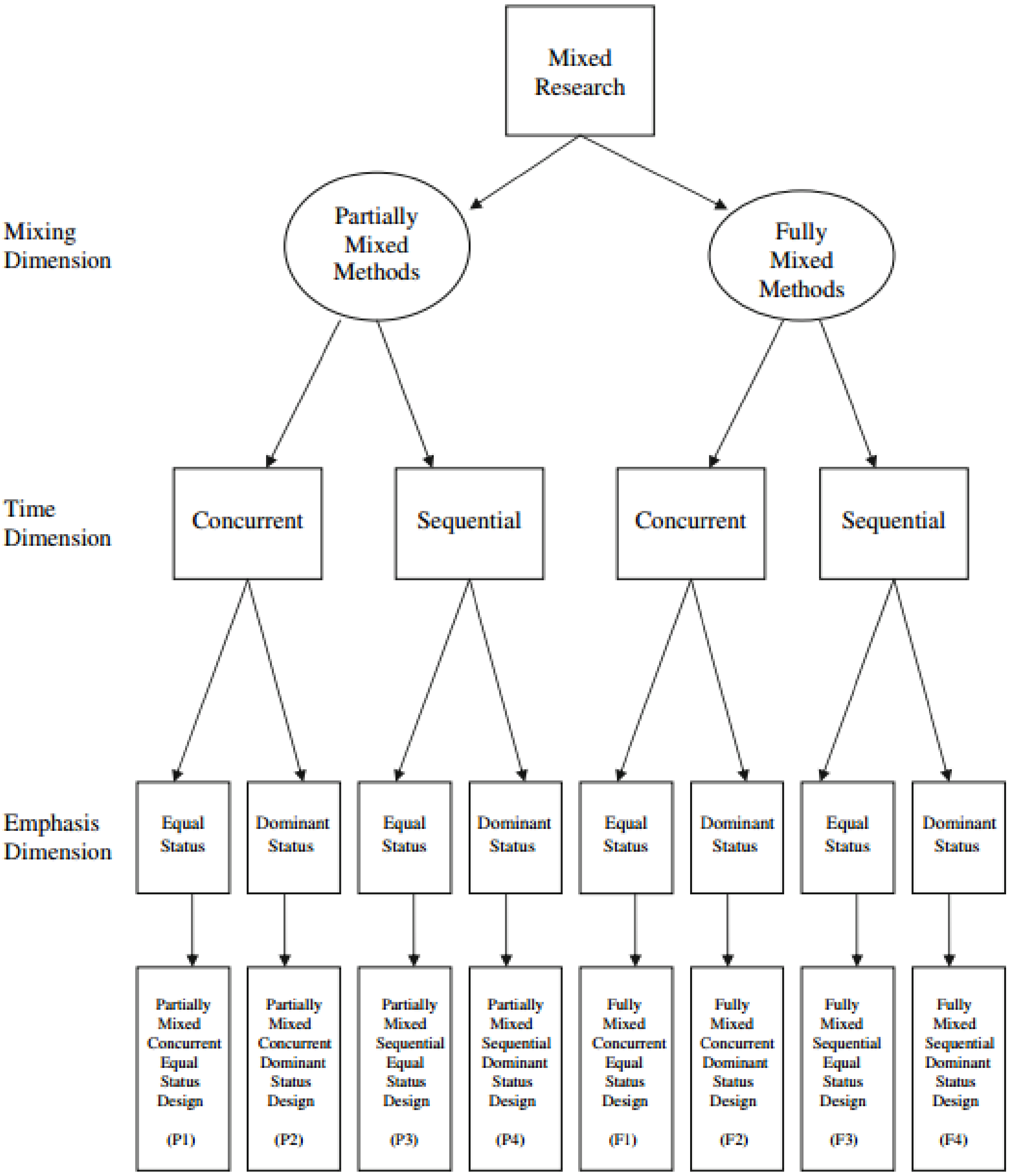



Figure 4.2. Mix method research typology
(source: (Leech & Onwuegbuzie 2009)

Creswell (2013) classified mix method strategies into three main groups – convergent parallel, explanatory sequential and exploratory sequential – which have proven to be very popular in recent studies. In the convergent parallel method, a researcher collects both quantitative and qualitative data, analyses them separately, and then compares both results to check whether they support each other. The researchers would incorporate the qualitative participant samples in the bigger quantitative sample since, eventually, they make a comparison between the two results and the similarity between results will validate the comparison. The explanatory sequential method is designed for the two-phase project, which starts with a strong quantitative method and follows up with qualitative methods. Researchers run quantitative sampling, analyse the results, and use the results to design a qualitative phase. Normally, quantitative results inform the types of participants to be selected purposefully for the qualitative section. In interpreting the results, the researchers explain both quantitative and qualitative results and then discuss how qualitative results help to develop and clarify the quantitative results. Because the qualitative questions narrow the scope of quantitative results. If we reverse the processes in explanatory sequential method and start with a qualitative approach, we have an exploratory sequential approach. This method begins with qualitative data collection and the second stage builds based on the results of qualitative data. The purpose of this approach is to develop rigour measurements with a specific number of respondents to check the generalisability of the results (in the first stage) to a large sample of the population (in the quantitative stage) (Creswell 2013).

Given the research focus on investigating the industry expert's views on port logistics integration, this study relies on a survey and interviews as the main data collection instrument. Thus, both quantitative and qualitative analysis are relevant and will be conducted. The reason for selecting quantitative analyses is based on the research scale and following similar important studies. The survey provides data collection in large populations and contributes to low costs per case (Almotairi & Lumsden 2009). Since the current research is investigating logistics integration on a large scale (Iranian seaports), the survey method would be the most suitable and cost-effective method. On the other hand, a literature review on logistics integration shows that few studies have investigated the challenges in port logistics integration in general and no study has been found on port logistics integration in particular. Therefore, more research is needed to determine the specific challenges in Iranian seaports besides the limited findings from the literature. Based on this fact, open-ended questions are used to gain deep insights regarding the challenges in Iranian seaports. Therefore, this research will use convergent a parallel mixed method approach. This study will use this method in two phases. In the first phase, a survey using Likert scale questions will be used to collect the challenges found in the literature and, in the second phase, open-ended questions will be used to collect qualitative data. Then, both sides will be compared to check whether they support each other.

### 4.2.1. Research strategy

According to Figure 4.1, the next research dimension relates to the research strategy, which is focused on a comprehensive plan of how to answer the research questions. As discussed in Chapter 2, the main gap is the lack of a comprehensive framework to measure different aspects of logistics integration. In terms of practical aspects in the Iranian context, there is no existent empirical study of logistics infrastructures and integration between logistics activities in the Iranian logistics industry and specifically in port logistics.

Based on the research onion (Figure 4.1), eight different strategies can be considered: namely experiment, survey, case study, action research, grounded theory, ethnography, archival research and narrative inquiry (Saunders *et al.* 2012):

According to the scope and objective of the research, the methods of experiment, action research, ethnography and narrative inquiry are not applicable to this study. For example, the experiment method aims at establishing the existence of a cause-and-effect relationship between two variables, while this study is looking at more complex relationships. As another example, grounded theory is a common method in business and management studies; however, the current study is not concerned with theory building (Collis & Hussey 2013). Rather, this research has used current theories and concepts (i.e. supply chain management concept) to develop the conceptual framework. Among other research strategies, the methods of archival research, case study and survey are the most applicable. In archival research, administrative records and documents use a principal or secondary source of data. Due to the time limits of the research studies, archival documents can answer only a few research questions which are about comparing the past and present (Saunders *et al.* 2012). Chapter 3 of this study uses archival documents on the logistics system in Iranian seaports. In fact, survey and case study can be considered as the most applicable research strategies for this research. The main difference between these two approaches is case studies produce rich descriptive data, whereas surveys do not. Instead, the data collected from surveys are more statistically significant in a highly economic and time effective way (Dawson 2016). Case study refers to a study in which an individual, group or a specific condition is considered. Case studies generally produced rich in-depth data, target a small population and use qualitative methods. Surveys, on the other hand, refer to research where data is collected from a whole population or a very large sample in order to understand the views on a specific problem. The survey can also use to propose possible explanations for specific relationships, which is most applicable to this research to answer the research questions.

The last section of the research onion (Figure 4.1) is related to the time horizon. There are two dimensions: cross-sectional and longitudinal. Cross-sectional studies are carried out once in a specific period, providing a snapshot of one point in time. Longitudinal studies extend repetitively for a long period (Cooper, Schindler & Sun 2003). The current study uses cross-sectional time zone to economise on time and cost. It is conducted only once at a specific time.

The justification for choosing this method to analyse the conceptual framework and study descriptors is grounded in the related research philosophy, methodological choices and literature review. The particular research philosophy and fundamental research concepts are based on highly cited studies such as Saunders *et al.* (2012), Tashakkori and Teddlie (1998) and Creswell and Clark (2007). On the other hand, similar studies in port studies and logistics integration studies note that methodological choices can be a suitable guide to increase the rigour of the study. Bandara and Nguyen (2016) used factor analysis to analyse influential factors in port infrastructure tariff formulation, which is similar to this study's aim of finding the influential factors in port logistics integration. Moreover, Pinmanee (2016), Robertson (2006), Song and Panayides (2008) and Panayides and Song (2009) conduct EFA/ CFA and related statistical methods in order to measure their constructs. Identifying the challenges in port logistics integration is followed by the study by Ghaderi (2016) which analysed the challenges of the rail sector in Australia.

## 4.3. A CONCEPTUAL FRAMEWORK FOR PORT LOGISTICS INTEGRATION

This section develops a conceptual framework for port logistics integration. The framework presents key influential factors as well as key challenges in port logistics integration. Such a conceptual framework is needed for various reasons including extending previous studies and filling the research gaps (as mentioned Chapters 1 and 2); developing logistics integration framework for the Iranian seaport industry; and identifying challenges in port logistics. The most important contribution of the framework is to highlight the role of resource sharing, organisational activities and institutional support as a crucial factor in port logistics integration, which has rarely been studied in a logistics context. Furthermore, this research makes the practical contribution of uncovering the related challenges of port logistics integration in order to provide a realistic view of the contemporary context.

This section explains the process of developing a conceptual framework for this study. The literature review of logistics integration in the general context reveals the research gap of the lack of a comprehensive framework in port logistics integration. Accordingly, this section will briefly outline the key factors regarding port logistics integration. Based on the definition by Tseng *et al.* (2005a), a logistics system comprises three main sections: logistics information systems, operations and physical activities, and logistics infrastructures and resources. Efficient collaboration between these main areas will lead to an integrated logistics system. Dominant studies in logistics integration in the port sector have focused on operations and information parts of a logistics system, while resources and infrastructures have not been studied as indicators of integrated logistics system in the port sector (Notteboom 2008; Song & Panayides 2008; Panayides & Song 2009; Bae 2012; Panayides & Song 2013).

The conceptual framework of the study synchronises existing thoughts and background in the research area, forms the basis of a study and directs the purpose of the research (Sinclair 2007). In order to develop the conceptual framework, the literature review process begins by recognising the rationale for review. This can be identified through problem formulation (mentioned in sections 1.1) which asks what field is being examined and what exactly are its components or issues. Therefore, considering the research problems and research questions, various keywords relating to four specific related areas, namely integration concept, logistics management, logistics/supply chain integration and port logistics integration are used to search for relevant studies (Alavi *et al.* 2018). As mentioned in Chapter 2, the idea for proposing the conceptual framework for port logistics integration was formed based on the study by Song & Panayides (2008). They introduced seven influential factors in the first study and combined them into four factors in their follow-up paper (Song & Panayides 2008; Panayides & Song 2009). Next, the current study conducted a structured analysis of 78 papers published in Scopus indexed journals in logistics, supply chain and port management during the period 2000-2017, the year that the current study's framework was developed. A multidimensional conceptual framework for port logistics integration was then proposed to incorporate the role of infrastructure variables emerging from the recent developments in the port logistics environment. An in-depth analysis of the papers in supply chain and logistics integration in different contexts (such as agricultural, maritime and manufacturing industries) revealed that three factors including organisational activities, institutional support and resource sharing can also contribute to the logistics integration framework (Pinmanee 2016; Alfalla-Luque, Medina-Lopez & Dey 2013, Monios 2016, Notteboom & Rodrigue 2005; Panayides and Song (2013), Wilmsmeier *et al*. (2015)).

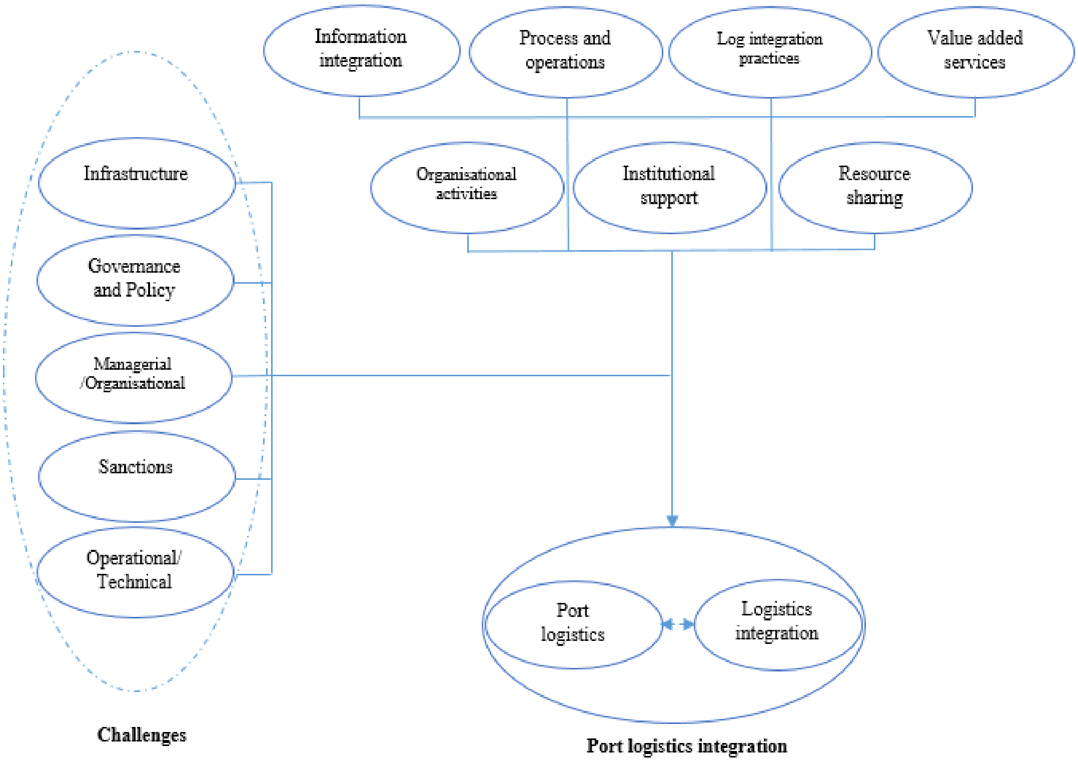



Figure 4.3. A conceptual framework of port logistics integration

Figure 4.3 presents the following key factors in port logistics integration:

- *Information integration*
- *Value-added services*
- *Processes and operations*

- *Logistics integration practices*
- *Organisational activities*
- *Institutional support*
- *Resource sharing*

As explained in the literature review in Chapter 2, the first four factors on the above list come from existing studies and the last three factors are proposed by this study to cover the gaps in the literature.

The left side of Figure 4.3 shows challenges in port logistics integration, particularly in Iranian seaports. As it can be seen in the conceptual framework, the four main challenges have been identified based on limited literature and reports on port logistics integration regarding infrastructure; governance model of the ports and policies; managerial, organisational and institutional issues; and international sanctions on the Iranian economy and maritime sector (Moradinasab Bahri 2018; Eshghi 2013; Miandoabchi 2007; Yousefi 2015). This study will consider the identified challenges and other possible barriers in port logistics integration in Iranian seaports.

The conceptual framework above shows how the influential factors and challenges of port logistics integration are interrelated. The study investigates both success factors and challenges of port logistics integration in order to attain a realistic view of the subject. The top section of the framework demonstrates that port logistics integration is influenced by seven factors (see bullet points). In other words, information integration processes and operations as well as value-added services (among other factors) need to work in unison to build an integrated logistics system. Meanwhile, the left section of the framework indicates the challenges and obstacles that limit the integration in the port logistics system. The framework suggests that, in order to have an integrated logistics system, the negative impacts of these five challenges need to be controlled and managed.

## 4.4. Questionnaire design

The study relies on a survey method using both Likert scale and open-ended questions. The survey questionnaire was developed based on the literature reviewed in chapter 2. The main part of the questionnaire includes questions concerning identifying the influential factors on port logistics integration based on existing knowledge on port integration studies and on logistics integration in the general context. The questionnaire has four main sections A to D. The sample of the questionnaire is presented in Appendix C.

***Section A. Respondents profile***

The main aim of this section is to categorise and classify respondents based on their characteristics to analyse the weight of each category based on the respondent's frequency. This section is an introductory section, asking simple questions from respondents to prepare them for answering the main items in the questionnaire. This section requests some demographic and administrative information of the survey participants, which includes the type of service, job experience, organisational level and the name of seaports they are familiar with.

***Section B. Port logistics integration***

With reference to the literature review in Chapter 2 and the conceptual framework in this chapter, this section will discuss the influential factors of port logistics integration including Information Integration (II), Value-Added Services (VAS), Processes and Operations (PO), Logistics Practices (LP), Organisational Activities (OA), Institutional Support (IS) and Resource Sharing (RS). This section covers the main section of the study which is prepared to answer the second subsidiary research question. Five-Point Likert scale questions were used in this section to collect data from the respondents with 1 denoting 'not important', and 5 representing 'very important'. The analyses method for this section will be explained later in this chapter.

***Section C. Challenges in port logistics integration***

This section is developed to answer the third research question on port logistics integration challenges. This section is designed to analyse the challenges (found from limited literature regarding the port logistics chain) and test them in Iranian seaports. As mentioned in Chapter 3, which discussed background information and the challenges in Iranian seaports, while there is no specific empirical research on the Iranian port logistics system, some reports identified challenges in this area. Infrastructure, governance and policy, managerial/organisational issues, operational/technical barriers and sanctions are the five main sources of challenges that have been identified in the literature (Carter *et al.* 2009; Forslund & Jonsson 2009; Awad & Nassar 2010a; Tejaratgostar 2014). Similar to section B, five-point Likert scale questions were used in this section to collect data from the respondents with 1 denoting ‘strongly disagree’, and 5 representing ‘strongly agree’.

***Section D. Open-ended questions***

As discussed in Chapter 3, there is no empirical study in this context-specific area. Hence, the current research aims to identify more challenges and explain the identified challenges and success factors for port logistics integration. In order to do this, open-ended questions have been used to ask participants about their experiences of challenges in the Iranian port logistics system. This section is designed to answer the research question three. Open-ended questions ask for the respondents’ ideas in five areas: 1) the challenges facing logistics integration in Iranian ports; 2) areas of improvement in port logistics integration; 3) the effect of sanctions on the Iranian logistics system; 4) the role of Iranian ports in comparison with neighbouring countries’ ports over the next 5-10 years; and 5) further recommendations for integrating logistics systems and overcoming the challenges in Iranian seaports. This chapter will also compare the responses from different actors’ perspectives to reveal their priorities on port logistics integration.

## 4.5. RESEARCH DESIGN

A research design is carefully devised to obtain the underlying arrangement of inquiries to be offered an explanation of some arrangement of conclusions about these inquiries (Yin 2013). From another perspective, research design is defined as research blueprints that deal with following questions: what the research questions are, what data are relevant, what data are to be collected, and how are the results to be analysed (Almotairi 2012). Figure 4.4 illustrates the research design procedure. The research process begins with construct development and establishes the research questions. It is then followed by questionnaire development, a pilot study for validating and revising the survey, data analysis of collected data and reporting the key findings of the study. Finally, the reliability and validity of the research are checked to confirm the quality of results and measurement tool, and its capability to decrease measurement error.

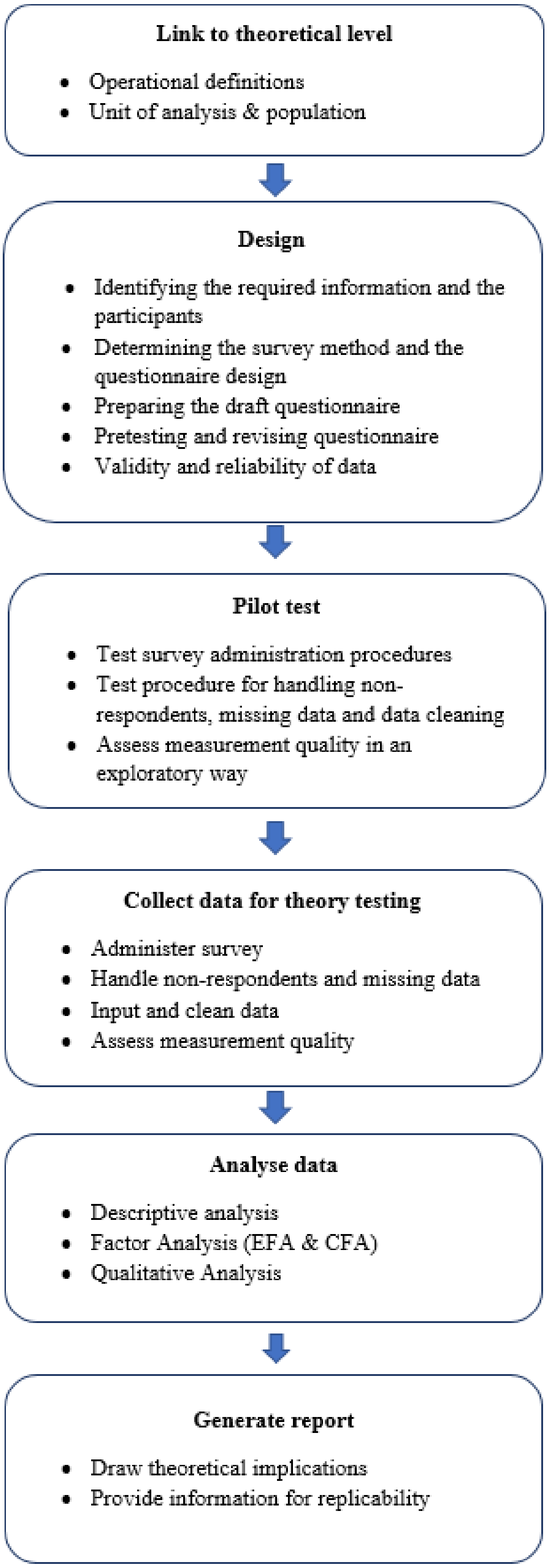



Figure 4.4. Research design process
Source: adapted from Pinmanee (2016)

This study begins with exploring the literature in order to identify influential factors in port logistics integration, followed by practical testing of the constructs and hypothesis. The study then seeks to identify the challenges of logistics integration in Iranian seaports, which will be tested using both qualitative and quantitative methods.

The process of designing a questionnaire contains five main steps. This includes identifying the required information and the participants, determining the survey method and the questionnaire design, preparing the draft questionnaire, pretesting and revising questionnaire, and validity and reliability of the data (Lorelle Frazer & Lawley 2000; Sayareh & Lewarn 2006). In the first step, the required information and participants are discussed. Based on Chapter 1, the primary purpose of the research is about collecting participants' opinions, ideas and perceptions about the proposed framework for port logistics integration and identifying its challenges in the Iranian context. To reach this aim, relevant questions about each recommended item are identified from different resources. The details of these items and selected factors will be discussed thoroughly in Section 4.6.

### 4.5.1. Sampling strategy and recruitment process

In this study, a self-administrative survey using both paper-based and online questionnaires will be used to collect data from port officials in Iranian seaports and their associations (internal port stakeholders) as well as other experts who are familiar with port logistics in different parts of the logistics chain. In addition, port users (e.g. shipping companies and agents, freight and logistics service providers, and other logistics chain members) are considered as the population. To collect data on site during the field trip, a paper-based questionnaire was used as a dominant method. Furthermore, an online survey was used chiefly for external stakeholders, such as shipping companies and logistics service providers. The online method was most suitable for external stakeholders due to their dispersion around the country and difficulty in finding them in a small geographical area, and the resources and time constraints of the project.

Due to the difficulty of accessing external port experts and lack of information regarding the number of the companies, stratified random sampling is used to collect data from logistics chain partners such as shipping companies, truck companies, logistics service providers. The study used a stratified purposeful sampling technique based on the method by Fricker (2008). Stratified random sampling involves the division of a population into smaller groups known as strata. The individuals targeted in this research were the experts and managers of port logistics chains in Iran. The population consisted of internal port stakeholders which mostly included port officials and maritime organisations in Iran as well as external port stakeholders or ‘port users’ including shipping companies and agents, terminals, freight and logistics service providers, transport companies and other related companies. As mentioned above, the population are divided into two strata to ensure a better representative sample. These two strata are non-overlapping in nature and relatively homogeneous (Biffignandi & Bethlehem 2012; Sakalayen 2014a). In order to collect data from these two strata, different methods have been chosen based on the availability of respondents. A paper-based self-administrative survey has been used for internal port stockholders in six major seaports (Section 3.3), and a questionnaire distributed in person by the researcher to all managers and experts in the six major seaports. In order to collect data from external stockholders, an online survey has been used to cover the potential respondents in each sector from all over the country. The details of the participant recruitment process are discussed below.

The paper base self-administrative survey, initial ground work involved the researcher coordinating with authorities and managers related to the port sector. The first authority engaged in the data collection process was the Ministry of Science, Research and Technology. In Iran, data collection and field trips must be conducted by external institutions and universities while under the supervision of the Ministry of Science, Research and Technology. The Ministry provided a letter as an invitation to Iranian Ports and Maritime Organisation responsible, who is for the port sector, to cooperate with the researcher in the data collection process. Next, the researcher sought permission and an invitation letter from the Iranian Ports and maritime organisation, which supervises all Iranian ports. After obtaining this support from the respective Iranian authorities, the researcher travelled to select Iranian seaports to collect data, as previously approved and coordinated with port headquarters. There are no statistical data about the number of experts and managers who are involved in logistics operations in the port logistics chain, but some other reports show there are almost 500 full-time port official experts in Iranian seaports and their associations (internal port stakeholders) (PMO 2015). According to a report by Iran’s Ports and Maritime

Organisation, there are 20 commercial seaports in Iran. As mentioned in Section 3.3, approximately 91 percent of Iran's loading and unloading is handled through six major ports (PMO 2017). Due to time and cost constraints, these ports have been selected as the sample for Iranian seaports for the paper-based questionnaire. The researcher visited all six ports and handed the questionnaire to all available experts and managers. The plan for collecting data from each port was conducted as follows. First, a meeting was held with all potential respondents (as explained before) in each port with the researcher explaining the project aim, its data collection procedure, research ethics, confidentiality, and related issues. Then, the following three choices were given to port officials willing to participate:

i. Fill out the survey and return it during the meeting;
ii. Fill out the survey and have the researcher return to the participants' offices to collect it;
iii. Complete the questionnaire by a specified date and send them to the central office of the port for the researcher to collect later.

To ensure confidentiality and anonymity, participants were invited to drop their complete survey questionnaires into a box provided.

The online survey questionnaire was designed using "Questionpro" (QuestionPro 2018). The managing directors, division managers, and senior experts were targeted due to their deemed knowledge about the characteristics of their organisations and connection to seaport logistics. Then, the contact details of potential participants – in particular, the email addresses – were collected from organisations' websites and LinkedIn profiles in each sector. The research found around 210 potential participants in the port users' stratum. Then, an invitation email was sent asking them to participate in the survey. The online survey link was sent to those who replied to the invitation. For those who did not reply, the first follow-up mail was sent 10 days after the first email, and then a second reminder was sent a week after the first follow-up mail. The follow-ups emails contained the survey link to make the process of answering the questionnaire easier for those who already missed the first email. In order to catch the attention of participants, the email title was changed but kept the main theme of the subject. Finally, the online data collection ended a week after the last reminder.

### 4.5.2. Bias management and error control measures

A number of researchers have emphasised the importance of using bias management strategies to ensure the quality of the research and maintaining ethical issues for bias-free report writing (Creswell 2013; Sakalayen 2014b). Being unbiased in research means that the researcher should remain independent and make no judgements across all research processes. In this research, the following strategies were taken to reduce bias:

- Using appropriate research terms;
- Incorporating all data in the report;
- Acknowledging the limitations;
- Asking open-ended questions to consider respondents' ideas about the research topic (rather than basing questions on existing ideas from the literature);
- Reviewing the guidelines and instructions of the university ethics committee and incorporating the suggested strategies to avoid bias in the research (Sakalayen 2014b; Taylor 2018).

Errors and mistakes during and after the data collection process are sometimes inevitable. The best way to control this is to identify the sources of errors and try to manage and decrease those errors. According to Sakalayen (2014a) and Dillman (2000), four types of errors may occur during the research process: coverage error, sampling error, measurement error and non-response error. Coverage error is related to not including all types of a target population. The current study invites select groups of participants from all parts of the port logistics chain (using a stratified sampling method). Therefore, missing and ineligible samples will be identified in the process. The next error is sampling error in which a small group of participants is considered the whole target population. To avoid this error, samples of port logistics chain members from each selected seaport are nominated to answer open-ended questions and a suitable proportion of participants (based on their numbers) is selected for survey data collection. Measurement error could reveal incorrect, vague or non-comparable answers by the respondents. In order to reduce the possibility of this error, pre-testing is used in the current study, which is explained in Section 4.7.3. In order to control non-response error control, the returned questionnaires should be inspected to assess their sustainability to use in the study. It was noted that some respondents missed one or two pages, some missed one or two questions, some answered every Likert scale question in the middle range, some provided unreliable answers (i.e. very likely or very unlikely boxes for most of the answers) or any other errors during answering the questionnaire. This kind of missing data can be corrected in 75 percent of cases (Robertson 2006) by sending the follow-up emails to respondents.

### 4.5.3. Pretesting and pilot study

A crucial part of the research design is a pilot study since they precede, and help directs the primary study. Pilot studies permit the researcher to test a small sample of respondents with the first version of the questionnaire. The main purpose of pretesting is to identify the possible errors or misunderstandings in questions and try to fix them before running the main questionnaire. Because the researcher identifies the errors during the data collection process, he/she will lose a great amount of time and cost, and in some cases, it is not possible to recollect the data (Sekaran 2006). The pilot study should be run in a similar way as the main data collection; for instance, if the surveys will be distributed by email, the pilot study will be sent by email as well (Pinmanee 2016). In this study, the pilot questionnaire has been sent to academia, research colleagues and experts who are working or have worked in port logistics and the supply chain area. The participants in the pre-test were asked to review the questionnaire, covering letter, information sheet, consent form and other related documents in terms of flow, order, skip patterns, timing, overall respondent impressions and grammatical and phrasing errors (Geer 2004). After considering pre-test results, the questionnaire was revised by deleting, adding and editing some of the questions. The reviewed documents were then submitted for ethics approval.

## 4.6. VALIDITY AND RELIABILITY

In order to have a rigorous research methodology, it is important to check its validity and reliability. Validity and reliability are concepts that check the assessment properties of a survey, questionnaire or other types of measurement tools (Atwork 2016). Validity is characterised as the degree to which an idea is precisely measured in quantitative research. In other words, it aims to analyse whether the measurement tool able to measure different dimensions of a concept. Reliability is related to consistency of a measurement tool, which shows that if the data collection process repeats several times, the results are approximately the same as responses each time the test is completed (Heale & Twycross 2015). This section is divided into two main parts: the validity and reliability of the quantitative research (the next two paragraphs), and the validity and reliability of the qualitative research (the last paragraph).

There are three major types of validity in quantitative analyses: content validity, construct validity and s criterion validity. Content validity looks at whether the instrument covers the whole area identified with the variable. Construct validity can be defined as the degree to which an examination tool measures the planned construct or measurement instrument should have three main features: homogeneity, convergence and theory evidence. Criterion validity measures whether an instrument is highly correlated with instruments measuring similar variables. It generally measures the correlations between variables (Heale & Twycross 2015). Based on the mentioned methods, the questions of the survey were prepared through a deep analysis of the literature review on port logistics integration to address the construct validity of the measurement tool. Furthermore, the content validity of the questionnaire is tested using pre-test in which participants commented to questionnaire items to ensure the quality of questions and items. Criterion validity checked during report writing through factor analysis results (Bryman & Cramer 2004).

In order to test the reliability of the study, this study applies the methods suggested by Saunders *et al.* (2009) including the test re-test parallel forms, split-half and internal constant. In the test re-test method, the measurement tool is tested in two different periods with one constant sample and the correlation coefficient is calculated. The parallel forms procedure is opposite to reset tests, entailing the testing of two measurement forms simultaneously and calculating and comparing the correlation coefficients. The split-half method is a measurement tool in which a test is divided into two sections and an individual's scores on both parts are analysed. The last method, internal constant, involves dividing the test into two main procedures: Kuder-Richardson and Cronbach’s alpha. A large number of quantitative studies use the second procedure to analyse the reliability of the measurement tool. Cronbach’s alpha is applied to evaluate the internal consistency measures in which correlations between a set of questions as a group (i.e. questionnaire item) are analysed (Ghiasvand 2013) as recommended by Meyers *et al.* (2016).

Regarding the reliability in qualitative research can be almost similar to quantitative research, according to Joppe (2000), the examination instrument is thought to be reliable if the aftereffects of a review can be repeated under a comparable strategy. Moreover, the main aim of reliability in qualitative research is the trustworthiness test (Golafshani 2003). Validity in qualitative research can be defined in different terms in qualitative studies such as quality, rigour and trustworthiness (Golafshani 2003). In order to check validity and reliability in the study, Creswell and Miller (2000) defined the triangulation method as “a validity procedure where researchers search for convergence among multiple and different sources of information to form themes or categories in a study”. However, practically, validity has been checked by the Kappa coefficient which will be further explained in Chapter 6 on qualitative analysis.

## 4.7. DATA ANALYSIS METHOD

Coding the answers in the questionnaire is the next step in the data analysis procedure. Regarding the first section on the respondents’ profile, the answers were coded utilising integer numbers beginning at one for the first item in the list and ‘n’ for the $n^{th}$ response. For example, ‘shipping operators’ was coded as 1 and ‘other’ was coded as 9. For the next section which is about the main part of the questionnaire, Likert’s five-point scale will be used in which 1 is for ‘very unlikely’ and 5 is ‘very likely’. Other steps for preparing data for analysis include recoding variables, and transforming and missing data management, which will be explained in detail in the next chapter on data analysis.

As discussed in Section 4.6 on questionnaire design, the research employed a parallel mixed method strategy using both questionnaires in the quantitative section and open-ended questions in the qualitative section to reach the objectives of the study. The first part of this section will focus on the quantitative analysis of using a survey.

### 4.7.1. Quantitative data analysis

Descriptive statistics are utilised to depict the fundamental elements of the information in a study. They give straightforward synopses to measure and sample using tools (such as mean, standard deviation, skewness, range and frequency) to analyse the first section of the questionnaire on respondents’ profile and their relationship with the main constructs and measures of the study (Robertson 2006). The details of the descriptive analyses will be explained thoroughly in the next chapter.

In order to analyse the influential factors in port logistics integration, both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were used. Factor analysis is a statistical method for data reduction. The logic behind the factor analysis is to reduce a large number of variables to their main factors. These factors are extracted based on factor analysis functions. The basic assumption of factor analysis is that underlying operating variables can be used to explain complex phenomena and the observed correlation between variables is the result of their participation in these factors. The aim of factor analysis is to detect unobservable (latent) variables based on a set of observed variables. In other words, factor analysis looks for joint variations in response to unobserved (latent) variables. It can be used where there are a large number of observed variables that are supposed to reproduce a smaller number of unobserved (latent) variables (Blaikie 2003; Bartholomew *et al.* 2008). This method is preferred by different researchers in order to find and examine the underlying factors among a large number of variables in the study (Nguyen 2013a, 2013b; Bandara 2015; Van der Eijk & Rose 2015; Fanam 2016).

Generally, there are two types of methods to test factor analysis:

*Exploratory factor analysis* is about discovering the underlying factors in a way that the proposed model has not been used in any study before. EFA is used when a researcher does not have enough background evidence to propose a hypothesis in order to extract a number of data. Therefore, there are two main goals of factor analysis; first, to determine the number of common factors, that can affect a set of variables; and second, to determine the severity of relationships between each factor (Alavi *et al.* 2014)

*Confirmatory factor analysis* is used to determine the structure of the underlying factor or confirming a deterministic hypothesis. Verification procedures (hypothesis testing) are used to determine that data with a certain factor structure (As developed in the hypothesis) coordinated or not (Ghasemi 2014).

There are more than 30 model fit indexes, most of which are computed and reported by AMOS (Ghasemi 2014). Although there is less agreement on the usefulness of each one, researchers generally classify the index into three groups:

- Absolute fit indices
- Comparative fit indices

- Parsimonious fit indices

Absolute fit indices are indicators developed based on the differences between observed variances and covariance on one side, and the predicted variances and covariance on the other side of the enamel of the model parameters. Among the most important absolute fit indices are Chi-square, Goodness-of-Fit Index (GFI) and Adjusted Goodness-of-Fit Index (AGFI) (Ghasemi 2014).

Comparative fit indices are in fact a step towards completing the absolute fit indices. This index considers one or more models as the base and compares it to the developed proposed theoretical model, checking whether it is considered statistically acceptable or not. In most cases, comparative fitting indicators show how well the model has been able to deviate from an independent model. The longer the distance is, the more meaningful the model fit is considered. The most important indicators include Normed Fit Index (NFI), Comparative fit index (CFI) and Incremental fit index (IFI) (Blunch 2012; Ghasemi 2014).

The third group of indexes are parsimonious fit indices. By presenting these fitting indices, an attempt has been made to compensate for the most important weakness of the absolute fit indices. In other words, by increasing the parameters of the model, the fitting index values are improved.

To illustrate this group of indicators, Kelloway (1998) asks the question: Is the paid cost (losing a degree of freedom) worth the profit (improvement in absolute fitness indicators)?

Both EFA and CFA were used sequentially in order to support each other and produce a model fit for latent variables (Bandara 2015).

To justify the data analysis method using factor analysis, relatively similar studies that used different forms of factor analysis were studied and analysed. The following research was consulted: evaluating the integration of seaport container terminals in supply chains (Panayides & Song 2008), supply chain integration, information technology, market orientation and firm performance in container shipping firms (Tseng & Liao 2015), influential factors in seaport infrastructure pricing (Bandara 2015), port integration in global supply chains: measures and implications for maritime logistics (Panayides & Song 2009).

### 4.7.2. Qualitative data analysis

Qualitative research is primarily considered as exploratory research that is used to determine fundamental causes, incentives and thoughts. Bogdan and Biklen (2007) defined qualitative research from the social and educational perspective as follows (Golafshani 2003, p. 4):

> Charts and graphs illustrate the results of the research, and commentators employ words such as ‘variables’, ‘populations’ and ‘result’ as part of their daily vocabulary…even if we do not always know just what all the terms mean…[but] we know that this is part of the process of doing research. Research, then as it comes to be known publicly, is a synonym for quantitative research.

According to Golafshani (2003), qualitative research encompasses four paradigms: 1) an emphasis on evidence and reasons of behaviour (Bogdan & Biklen 2007); 2) data transferred to statistics that can be measured and summarised; 3) a mathematical method used as a common process to analyse the statistical data; and 4) the final result is articulated in numerical terms. In order to put these four paradigms into practice, one of the most commonly used methods by researchers is Nvivo software.

To analyse the collected data from open-ended questions, the researcher had the option of using two common methods. The first method analyses the transcription and attempts to identify key points in each open-ended question and analyse the differences and similarities between them (Creswell 2013). The second method is using qualitative analysis tools such as Nvivo, which can help researchers to analyse the collected data more precisely, providing charts and visual tools to clarify and explain the results. This study utilised Nvivo tools to analyse the data. Chapter 6 will explain the data analyses in further detail.

## 4.8. RESEARCH ETHICS

Ethics in business research is defined as a set of principles and adherence to expected social standards and practices while conducting research (Veal 2005). Ethical conduct should also be demonstrated in the conduct of the researchers who execute the examination, the members who give the information, the investigators who provide the outcomes and the presentation of the literature review discoveries. Ethical considerations should be considered at every stage of data collection, analysis, and publishing the findings of the study in journals or at conferences (Pinmanee 2016).

The purpose of the current study and initial information about its components were introduced to participants in the first stage of the questionnaire. In the next stage, it was explained that the participation in this study is optional and it is their decision whether or not to take part in the data collection process. They were notified that if they agreed to participate, their individual responses would be kept confidential and would only be analysed to reach the research objectives. Furthermore, respondents were told that they would be informed of the study results by way of any published reports or articles (Robertson 2006).

According to Sakalayen (2014a) and Creswell (2013), addressing research ethics involves the following steps:

- Issuing a consent form before starting to collect data. The ethical issues should mention in this form to guarantee the participants' prosperity.
- An information sheet consisting of the research purpose, the aim of the invitation, the role of participants, expected risks, research results, confidentiality, data collection procedure, and the complaint process (if applicable).
- Preparing a cover letter with a questionnaire and formally inviting participants to take part in the data collection process. The expected timeframe for data collection should be mentioned in this form.

This study has followed the considerations of the ethics committee of the University of Tasmania under the authority of the Human Research Ethics Committee (Tasmania) network [HREC (TAS)] (UTAS 2017). Moreover, the data collection process is conducted in Iranian seaports, which are under the supervision of Iran's Ports and Maritime Organisations along with the Iranian Ministry of Science, Research and Technology. After contacting and applying to these two bodies, the researcher obtained permission to enter the ports and collect data from different supply chain members in the port logistics chain.

## 4.9. SUMMARY

This chapter presented the details of the research methodology used in this study to answer the research questions and research objectives. The chapter aimed to review a range of research philosophies, methods and procedures to find the best approach for identifying the influential factors and challenges in port logistics integration influential in Iranian seaports. The chapter begins with a brief introduction to the methodology section. The methodology has been justified by reviewing similar studies and their related concepts, theories and research philosophies. The next section discussed and explained the conceptual framework of the study and constructs in this framework. Based on the proposed framework, the questionnaire was designed using paper-based and online methods in two strata: internal and external seaport stakeholders. The total population included targeted managers and experts in the Iranian port logistics system. Due to the limited availability of respondents and researchers' constraints, the data gathering, and recruitment process were reviewed using both online and paper-based survey. The study applied bias management and error control measures to check the quality of the research and abide by the relevant ethical guidelines. Pre-testing and pilot studies were conducted as a quality control measure to check the appropriateness of the study and to clarify the content of the survey. The study briefly reviewed the qualitative and quantitative data analysis tools and techniques which will be employed in Chapters 5 and 6. In the last part of the chapter, the research ethics were briefly discussed.

# CHAPTER 5: QUANTITATIVE DATA ANALYSIS

## 5.1. Introduction

The aims of this chapter and the next chapter (Chapter 6) are to report the results of the survey of port logistics integration in Iranian port sector. Following the last chapter on methodology, this chapter presents the results and findings of the quantitative analyses, in order to answer the second secondary research question and partially address the third research question, shown below:

- SRQ2: What are the critical factors in logistics integration from the Iranian ports' perspective?
- SRQ3: What are the challenges facing Iranian port logistics integration?

The chapter is divided into eight sections. Section 5.2 discloses the response rate in both paper-based and online questionnaire. Section 5.3 explains the collation and validation of the data set. Section 5.4 presents the respondents' profiles including population, sample size and response rate. Section 5.5 presents the descriptive statistics of variables. Sections 5.6 and 5.7 present the results of the explanatory factor analysis (EFA) and confirmatory factor analysis (CFA) of critical factors in logistics integration, respectively. Similarly, Sections 5.8 and 5.9 reports the results of EFA and CFA concerning the challenges in Iranian logistics integration, respectively. Finally, the last section summarises the key findings from the data analyses.

## 5.2. The response rate

The questionnaire was distributed to Managers and experts in port logistics chain divided into two strata, including port officials (internal port stakeholders), and port users (external port stakeholders) as mentioned in section 4.6. A total of 469 questionnaires were distributed to potential participants, 259 of them opting for self-administrative surveys and 210 of them using the online survey. Ultimately, 161 questionnaires were collected from the self-administrative method and 74 questionnaires were collected from the online survey. This gives the response rate of 62 percent for the self-administrative survey, 35 percent for the online survey, and 50 percent for the total distribution.

## 5.3. DATA VALIDATION

After completing data collection, the responses were pre-processed before data analysis was carried out. This preliminary step was necessary to make sure that each respondent's profile reflected the pre-defined population. Hence, the collected survey questionnaires were checked and the data was aligned with the selected sample and targeted population, with no unexpected questionnaire found. Next, the data set was checked for errors, invalid entries and missing values; this was a process of checking the mistakes or any missing data in the collected questionnaires. Therefore, any inconsistent, ambiguous or incomplete questionnaire was excluded from data analysis. Of the total 235 surveys returned by the participants, 23 were excluded from analysis due to missing data, erroneous entries and incompletion. Because ineligible responses were very few (9.7 percent of collected questionnaires) compared with the sample size, incomplete responses can be disregarded (Sreejesh *et al.* 2014).

As detailed in Chapter 4, the questionnaire has four parts including respondent profile, influential factors of port logistics integration, challenges factors regarding port logistics integration in Iranian seaports and open-ended questions. The questionnaire was designed based on a Likert scale ranging from 1 (not important) to 5 (very important). The scale was the same for challenges in Iranian seaports, again ranging from 1 (strongly disagree) to 5 (strongly agree).

## 5.4. RESPONDENTS' PROFILE

This section details the profile of the participating respondents. The results of the demographic and respondents' profile help to investigate the characteristics of respondents and analyse the differences and similarities between a range of port logistics actors. In the first section of the questionnaire, the respondents were asked to answer questions regarding the four aspects of their work: their types of service or their positions in different parts of the port logistics chain; job experience; their position in the company or organisational level; and the name of the seaport(s) that they have work knowledge.

### 5.4.1. Type of service

Figure 5.1 indicates different actors in the port logistics chain such as port authority, terminal, stevedoring, warehousing, shipping company, land transport (road & rail), logistics/freight forwarding, export/import, manufacturing and others (if any). As shown by the figure, around 45 percent of respondents have experience relevant to port management (Iranian Port and Maritime Organisation), which means that they are focal firms in the seaport logistics chain and working with almost all actors in the chain. The second largest category at 20 percent is related to shipping companies. Other actor contributions in this study include terminal operators with 15 percent, import and export companies with 6 percent, logistics/freight forwarding companies with 5 percent, stevedoring with 4 percent, transport companies (land and rail), and warehousing with around 3 percent.

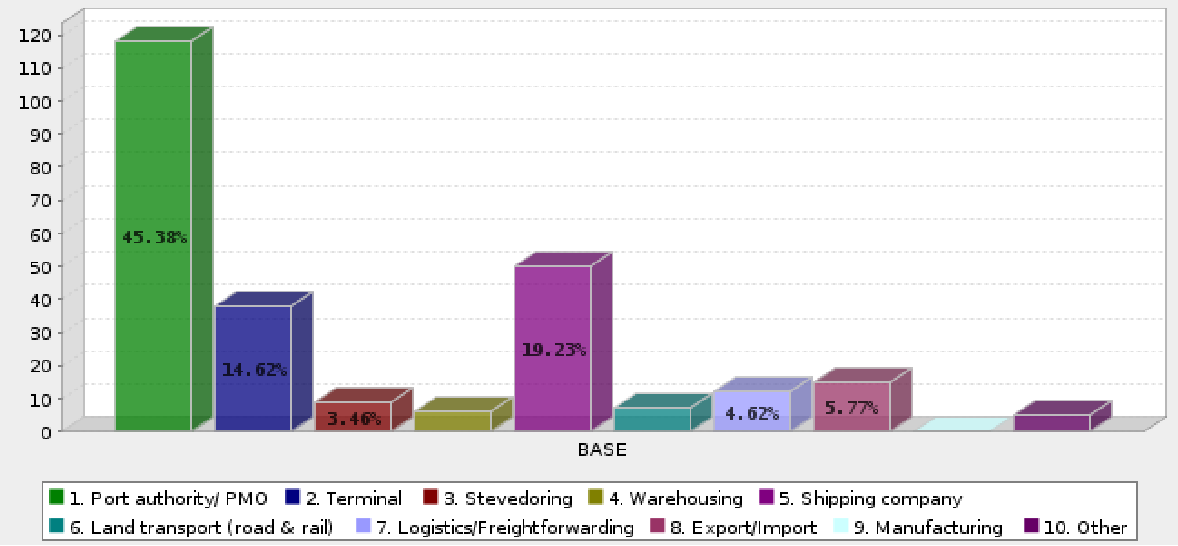


Figure 5.1. Type of services

### 5.4.2. Job Experience

Figure 5.2 indicates the number of years' experience in port logistics and operational management by the respondents. The results show that around 92 percent of the respondents had more than 6 years of experience. It shows that responses to the questionnaire came from a sample of experienced people holding authority positions in the port logistics chain. It also shows that respondents with 10-19 years of experience were a dominant group representing more than 40 percent, while around 8 percent of the total respondents had less than 5 years of experience and more than 27 percent had more than 20 years of experience. The experience range confirmed practical and insightful data collection through the survey.

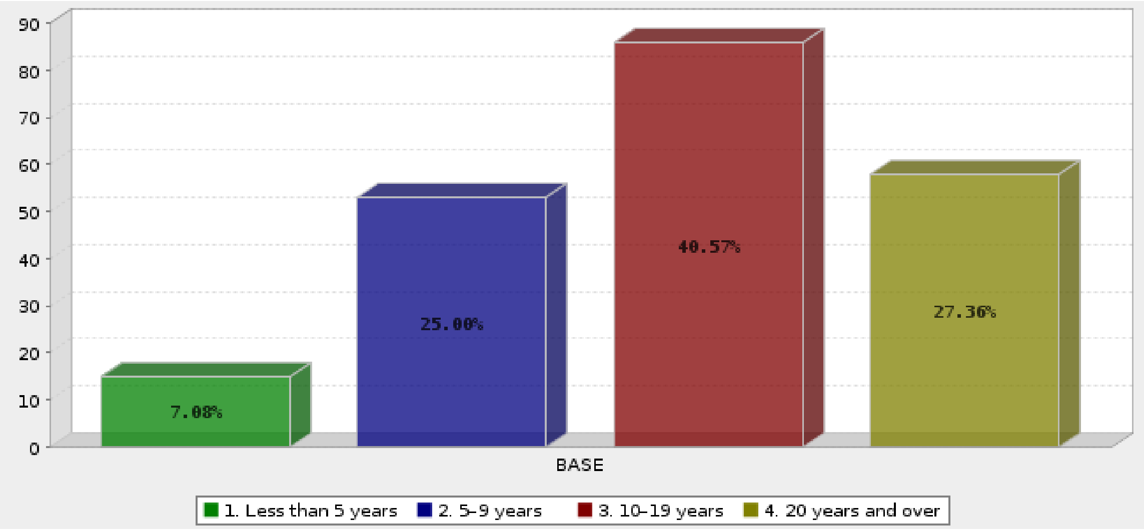



Figure 5.2. Related job experience

### 5.4.3. Job position

Figure 5.3 represents respondent's job positions in their organisation. Around 37 percent of respondents held senior positions, while more than 6 percent and 10 percent of the respondents were the chief executive officers (CEO) and general managers, respectively. Moreover, around 16 percent were technical managers, 20 percent were division managers and 7 percent were experts. Around 5 percent of respondents held other positions and almost all of them were categorised as senior or top-level managers. Overall, more than 56 percent of respondents were managers and top-level authorities, and the rest of them were experienced and senior experts, thereby meeting the goals of the study to collect data from experienced and higher-level employees.

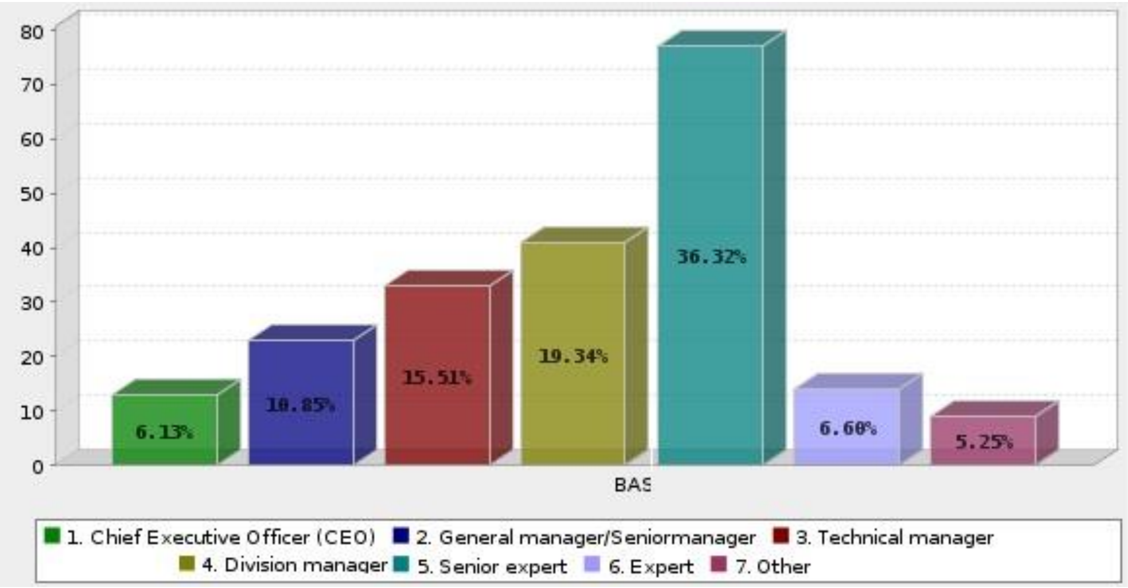



Figure5.3. Organisational level

### 5.4.4. Location of the seaports studied

The last question in the first part of the questionnaire was related to participation rate in different Iranian seaports. As it can be seen in Figure 5.4, around 44 percent of participants were familiar with Rajaee and Imam Khomeini seaports, which are two important seaports in Iran, handling more than 70 percent of imports and exports for the region. Moreover, 13 percent of participants were from Anzali port, 12 percent from Bushehr port, 11 percent from Chabahar port, 8 percent from Amirabad port, 4 percent from Khorramshahr, 3 percent from Noshahr port, 2 percent from Abadan port, and another 2 percent were small ports such as Khark or Kish seaports.

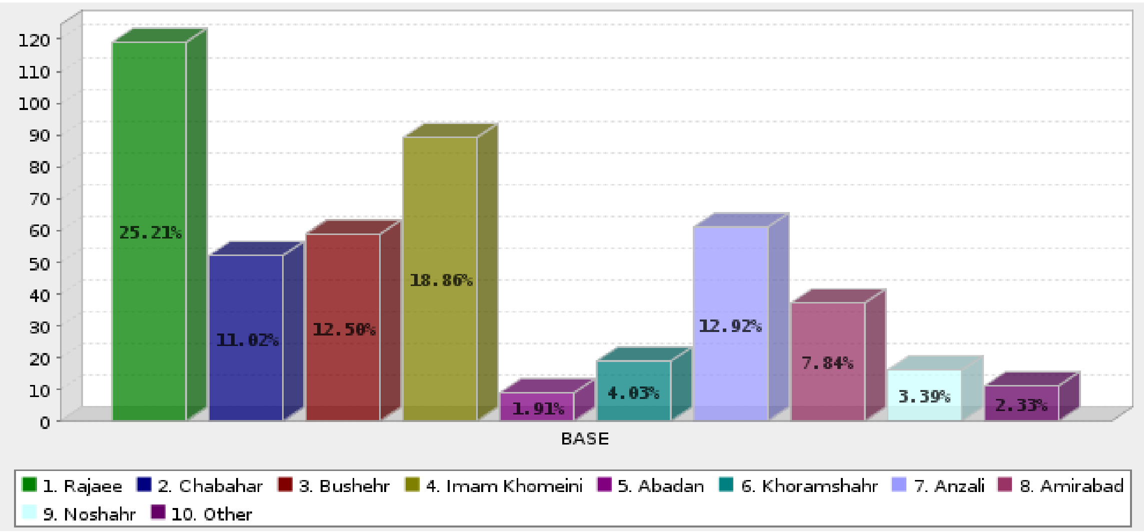



Figure 5.4. Participation in different ports

## 5.5. DESCRIPTIVE STATISTICS OF VARIABLES

### 5.5.1. Descriptive statistics of the influential factors of port logistics integration

The following descriptive statistics results are presented related to the response received on each of 212 collected questionnaires, where 5-point Likert scale questions testing less important to very important constructs were used to gathered respondents view on the influential factors of port logistics integration.

Based on the identified factors, the most influential factors of port logistics integration were categorised into seven sections. The first section addressed questions (II) (II1 to II9) on information integration. According to Table 5.1, ‘using modern information and communication technology (ICT) facilities and devices’ has the greatest mean among its items, meaning that modern ICT facilities will likely help the logistics chain to be or remain integrated. 'Using advanced IT to control container flow’ and ‘using advanced IT to book space for containers' items appear to be the second and third important items under this factor.

Table 5.1. Information and communication integration items

| Item | | Survey question | Mean | Std. Deviation | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| 2.1.1 | II1 | Regular communication with logistics partners | 4.1934 | .67125 | .451 | -.248 | -.797 |
| 2.1.2 | II2 | Sharing useful information | 4.1226 | .64877 | .421 | -.334 | .185 |
| 2.1.3 | II3 | Using modern ICT facilities and devices | 4.3868 | .70302 | .494 | -.789 | -.283 |
| 2.1.4 | II4 | Using advanced IT to control container flow | 4.3443 | .70832 | .502 | -.929 | 1.214 |
| 2.1.5 | II5 | Using advanced IT to book space for containers | 4.2406 | .70453 | .496 | -.541 | -.233 |
| 2.1.6 | II6 | Using databases to share supply chain information | 4.2264 | .67848 | .460 | -.497 | -.030 |
| 2.1.7 | II7 | High level of accuracy of the shared information | 4.2736 | .64629 | .418 | -.331 | -.705 |
| 2.1.8 | II8 | Using a high level of website transaction with partners | 4.2311 | .71436 | .510 | -.529 | -.326 |
| 2.1.9 | II9 | Adopting electronic data interchange (EDI) | 4.1840 | .66684 | .445 | -.324 | -.368 |

The second section addressed value-added services (VAS) (VAS1 to VAS7) questions. Among seven items which describe the value-added services factor, 'capacity to convey cargo through the most diversified routes/modes' has the greatest mean. 'Making quick decisions regarding changing design processes' and 'using maintenance and repair facilities' items can be considered the second and third important items under this factor.

Table 5.2. Value-added services items

| Item | | Survey question | Mean | Std. Deviation | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| 2.2.1 | VAS1 | Adequate facilities for adding value to cargoes | 3.9670 | .68418 | .468 | -.138 | -.347 |
| 2.2.2 | VAS2 | Value-added logistics storage equipment | 3.8349 | .75796 | .575 | -.110 | -.496 |
| 2.2.3 | VAS3 | Using maintenance and repair facilities | 3.9764 | .78155 | .611 | -.440 | .151 |
| 2.2.4 | VAS4 | Involving the partners in the development process | 3.9340 | .73205 | .536 | -.189 | -.413 |
| 2.2.5 | VAS5 | Create mutual value for targeted consignees | 3.8113 | .71693 | .514 | -.093 | -.327 |
| 2.2.6 | VAS6 | Capacity to convey cargo through the most diversified routes/modes | 4.2311 | .68731 | .472 | -.423 | -.486 |
| 2.2.7 | VAS7 | Making quick decisions regarding changing design processes | 4.0283 | .75986 | .577 | -.309 | -.518 |

Respondents were asked to indicate the importance of eight questions on operations and processes (PO) (PO1 to PO8). Table 5.3 shows the descriptive statistics of the items. Most of the respondents think that connectivity/operability for ship/ (road/rail) interface, using intelligent clearance,precise schedules and accurate transfer times can describe process and operations.

Table 5.3. Processes and operation items

| Item | | Survey question | Mean | Std. Deviation | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| 2.3.1 | PO1 | Level of modal shift among different modes of transportation | 3.7830 | .75419 | .569 | -.220 | -.232 |
| 2.3.2 | PO2 | Using intelligent clearance | 4.2028 | .79178 | .627 | -.841 | .664 |
| 2.3.3 | PO3 | Connectivity/operability for ship/(road/rail) interface | 4.2972 | .76746 | .589 | -.946 | .860 |
| 2.3.4 | PO4 | Joint transport planning, management and control processes | 4.0425 | .72405 | .524 | -.518 | .306 |
| 2.3.5 | PO5 | Make a contract with partners for a quality service level | 3.9670 | .73751 | .544 | -.306 | -.227 |
| 2.3.6 | PO6 | Provide safer, more reliable and integrated services | 4.0472 | .73352 | .538 | -.219 | -.687 |
| 2.3.7 | PO7 | Relationship based on mutual trust and commitment | 4.1415 | .75336 | .568 | -.441 | -.502 |
| 2.3.8 | PO8 | Schedule precise and accurate transfer times | 4.1840 | .66684 | .445 | -.615 | .847 |

In Section 2.4 of the questionnaire, respondents were asked to indicate the importance of 7 questions related to logistics practices (LP) (LP1 to LP7). Based on the results of the analysis in Table 5.4, 'identify transport modes for linking port/terminal ,' 'identifying least-cost options for transport' and 'evaluating alternative routes for increasing transport efficiency' can be considered as the three most important items under the logistics practices factor.

Table 5.4. Logistics practices items

| Item | | Survey question | Mean | Std. Deviation | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| 2.4.1 | LP1 | Evaluating alternative routes | 4.0991 | .71848 | .516 | -.227 | -.783 |
| 2.4.2 | LP2 | Collaboration with channel members | 3.9811 | .70181 | .493 | -.472 | .438 |
| 2.4.3 | LP3 | Benchmark logistics management options | 4.0000 | .79691 | .635 | -.454 | .028 |
| 2.4.4 | LP4 | Identifying least-cost options for transport | 4.0613 | .76723 | .589 | -.296 | -.721 |
| 2.4.5 | LP5 | Identify transport modes for linking port/terminal | 4.0613 | .72922 | .532 | -.391 | -.177 |
| 2.4.6 | LP6 | Integrated promotion activities for the port | 4.0189 | .74122 | .549 | -.242 | -.567 |
| 2.4.7 | LP7 | Offering support for customers to choose their preferred channel | 3.8632 | .75737 | .574 | -.493 | .555 |

Section 2.5 of the questionnaire addressed organisational activities (OA) (OA1 to OA6) questions. Results of the analysis in Table 5.5 indicate that most of the respondents think that 'building interpersonal trust to create/maintain long-term relationships', 'guiding organisations towards a joint search for end-customer satisfaction' and 'encouraging teamwork for work in diverse situations can describe organisational activities that help integrate the port logistics system.

Table 5.5. Organisational activities items

| Item | | Survey question | Mean | Std. Deviation | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| 2.5.1 | OA1 | Sharing risks, costs and rewards | 3.7972 | .77361 | .598 | -.314 | .154 |
| 2.5.2 | OA2 | Building interpersonal trust to create/maintain long-term relationships | 4.0236 | .78759 | .620 | -.512 | -.109 |
| 2.5.3 | OA3 | Guiding organisations towards a joint search for end-customer satisfaction | 4.0283 | .74729 | .558 | -.252 | -.605 |
| 2.5.4 | OA4 | keeping the interests of all stakeholders in mind | 3.9245 | .73759 | .544 | -.309 | -.140 |
| 2.5.6 | OA5 | Encouraging teamwork for work in diverse situations | 4.0000 | .70206 | .493 | -.166 | -.474 |
| 2.5.7 | OA6 | Encouraging teamwork for placing a new employee into an existing team | 3.8915 | .73667 | .543 | -.113 | -.514 |

In Section2.6 of the questionnaire, respondents were asked to indicate the importance of seven questions related to institutional support (IS1 to IS7). Table 5.6 shows the descriptive statistics of the items. Although all the items are in the acceptable range (above 3), the respondents were more often agreed with factors such as 'identify and implement the best practices in freight transport', 'providing vocational education for identifying and defining logistics strategies in cargo distribution' and 'financial support for logistics providers to build new facilities'.

Table 5.6. Institutional support items

| Item | | Survey question | Mean | Std. Deviation | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| 2.6.1 | IS1 | Identify and implement the best practices in freight transport | 4.1132 | .73917 | .546 | -.254 | -.906 |
| 2.6.2 | IS2 | Financial support for logistics providers to build new facilities | 3.9906 | .73498 | .540 | -.202 | -.548 |
| 2.6.3 | IS3 | Approving business loans/microcredit facilities with lower interest rates | 3.9575 | .83926 | .704 | -.357 | -.371 |
| 2.6.4 | IS4 | Facilitating leases with the aim of improving logistics of cargo distribution | 3.8962 | .72764 | .529 | -.285 | -.100 |
| 2.6.5 | IS5 | Understanding and assessing inter-relationships among logistics functions | 3.9151 | .73010 | .533 | -.015 | -.766 |
| 2.6.6 | IS6 | Providing vocational education | 4.0708 | .73484 | .540 | -.546 | .642 |
| 2.6.7 | IS7 | Organising, inviting and assisting participation in educational activities | 3.7736 | .73868 | .546 | -.182 | -.224 |

Finally, Section 2.7 of the questionnaire addressed resource-sharing (RS1 to RS5) items. Respondents were asked to indicate the importance of these items. Table 5.7 indicates the descriptive statistics of the items. Based on the results of the analysis in Table 5.7, ‘searching optimisation in the procurement and distribution of cargos throughout the supply’ and ‘design and joint development of packaging’ are the most important items under this factor.

Table 5.7. Resource-sharing items

| Item | | Survey question | Mean | Std. Deviation | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| 2.7.1 | RS1 | Involving the supply chain members in decision making | 3.8679 | .81544 | .665 | -.388 | -.286 |
| 2.7.2 | RS2 | Searching for optimal subcontracting for the entire supply chain | 3.8821 | .77292 | .597 | -.291 | .034 |
| 2.7.3 | RS3 | Design and joint development of packaging | 3.9292 | .78474 | .616 | -.350 | .005 |
| 2.7.4 | RS4 | Shared use of containers to facilitate handling operations | 3.8726 | .77753 | .605 | -.324 | -.237 |
| 2.7.5 | RS5 | Searching optimisation in the procurement and distribution of cargos throughout the supply chain | 4.0189 | .72832 | .530 | -.475 | .607 |

As it can be seen in Tables 5.1 to 5.7, the mean values for all the responses are higher than the respective mean point of the 5-point Likert scale, which is 3. This highlights that respondents have enough knowledge about the factors, function and activities that lead to port logistics integration. Furthermore, the average in different descriptive statistics including mean, standard deviation, variation, skewness and kurtosis indicates that the results are acceptable for parametric statistical tools and to start the analysis (Fanam 2016).

The mean values in Tables 5.1 to 5.7 show that respondents agreed with questions regarding the influential factors of port logistics integration. Moreover, the coefficient of variation (CV), CV < 1 indicates low-variance, while CV > 1 indicates high-variance (Broverman 2001). Regarding the coefficient of variations in the tables above, the observed variance is considered within the acceptable range. The acceptable range for skewness or kurtosis is below +1.5 and above -1.5 (Tabachnick 2013). As evident from Tables 5.1 to 5.7, skewness and kurtosis are in the acceptable range.

### 5.5.2. Descriptive statistics of the challenges in Iranian port logistics integration

The following descriptive statistics results (Tables 5.8 to 5.12) are examined in relation to the respondents' views on the challenges in Iranian port logistics integration. From the 212 collected questionnaires, responses were measured using 5-point Likert scale ranging from 1 = strongly disagree, to 5 = strongly agree.

Based on the identified factors, the challenges can be categorised into five sections. Section 3.1 of the questionnaire addressed infrastructure challenges (IN) (IN1 to IN3). Among three items that describe the factor of infrastructure, 'lack of appropriate infrastructure in ports logistics and transportation systems' has the largest mean. In addition, the respondents think that there is no comprehensive plan but rather an insufficient investment in Iranian seaports.

Table 5.8. Infrastructural challenges items

| Item | | Questions' summery | Mean | Std Deviation | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| 3.1.1 | IN1 | Insufficient investment in ports | 3.7830 | .95892 | .920 | -.627 | -.065 |
| 3.1.2 | IN2 | Lack of appropriate infrastructure | 3.9575 | .87248 | .761 | -.609 | -.006 |
| 3.1.3 | IN3 | Lack of a comprehensive plan for development | 3.7453 | .97903 | .959 | -.479 | -.471 |

Section 3.2 of the questionnaire, questions GP1 to GP3 pertain to governance and policy issues. Respondents were asked to indicate the degree to which they agree with items related to such issues. Table 5.9 indicates the descriptive statistics of the items. The impact of global economic crises and lack of support for development strategies from the government are considered challenges in this factor. On the other hand, the second item related to insecurity in waters has the mean value of 2.94 which shows that the respondents have an overall negative view on this item.

Table 5.9. Governance and policy challenges items

| Item | | Questions' summery | Mean | Std Deviation | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| 3.2.1 | GP1 | Impact of the global economic crisis on Iranian shipping | 3.9245 | .83409 | .696 | -.302 | -.626 |
| 3.2.2 | GP2 | Insecurity in waters where pirates are active | 2.9481 | .91442 | .836 | .291 | -.171 |
| 3.2.3 | GP3 | Lack of support for development strategies from government | 3.7217 | .77454 | .600 | -.275 | -.210 |

The respondents were asked to determine the extent to which they agree with the statements in Section 3.3 of the questionnaire. This section addressed operational and technical (OT) items OT1 to OT6. As shown in Table 5.10, all items are in the acceptable range (above 3), with respondents more often agreeing with factors of 'poor freight distribution systems', 'poor information access'' and lack of coordination in port activities'.

Table 5.10. Operational and Technical challenges

| Item | | Questions' summery | Mean | Std Deviation | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| 3.3.1 | OT1 | The disintegration of the ports in the north and south | 3.3962 | .90475 | .819 | -.171 | -.365 |
| 3.3.2 | OT2 | Oversupply in busy ports which leads to bottlenecks | 3.4953 | .93128 | .867 | -.537 | .072 |
| 3.3.3 | OT3 | Poor freight distribution systems | 3.7453 | .83253 | .693 | -.089 | -.656 |
| 3.3.4 | OT4 | High terminal charges | 3.5236 | .92075 | .848 | -.199 | -.474 |
| 3.3.5 | OT5 | Lack of coordination in port activities | 3.5755 | .88642 | .786 | -.293 | -.252 |
| 3.3.6 | OT6 | Poor information access | 3.7075 | .88663 | .786 | -.296 | -.401 |

Section 3.4 of the questionnaire represents the results of the analysis for managerial and organisational (MO) (MO1 to MO4) challenges, as illustrated in Table 5.11. Most of the respondents think that the shortage of skilled human resources and lack of integrated supply chain thinking can describe managerial and organisational challenges in Iranian seaports.

Table 5.11. Managerial and organisational challenges

| Item | | Questions' summery | Mean | Std Deviation | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| 3.4.1 | MO1 | Rigidity of the laws and regulations governing maritime transport | 3.6651 | .88490 | .783 | -.200 | -.465 |
| 3.4.2 | MO2 | Lack of integrated supply chain thinking | 3.8821 | .84890 | .721 | -.335 | -.545 |
| 3.4.3 | MO3 | Poor customer relationship management | 3.5472 | .99888 | .998 | -.520 | -.252 |
| 3.4.4 | MO4 | Shortage of skilled human resources | 3.9528 | .82476 | .680 | -.321 | -.609 |

Finally, Section 3.5 presents the results of the analysis for the sanctions )SA( (SA1 to SA4). As shown in Table 5.12, 'Problems with financial transactions' has the greatest mean among its items. That is, due to financial problems, it is very hard to transfer the money between logistics partners. Hence, financial transactions are considered one of the most important chains in the port supply chain. The second issue in sanctions is also related to financial and investment issues. Therefore, the priority for Iranian policy makers and port managers would be trying to solve this issue and effectively reduce the challenges in Iranian port logistics system.

Table 5.12. Challenges related to sanctions

| Item | | Questions' summery | Mean | Std Deviation | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| 3.5.1 | SA1 | Economic international sanctions | 4.0330 | .83402 | .696 | -.458 | -.530 |
| 3.5.2 | SA2 | Problems with Financial transactions | 4.1226 | .78133 | .610 | -.580 | -.156 |
| 3.5.3 | SA3 | Problems with investment and securing financial credit from banks | 4.0991 | .73155 | .535 | -.303 | -.623 |
| 3.5.4 | SA4 | Unwillingness of financial institutions and credit institutions to invest | 4.0236 | .85121 | .725 | -.743 | .575 |

In the fourth section of the questionnaire, the respondents were asked to indicate their general opinion about the level of port logistics integration in Iranian seaports (from 1 being 'very low' to 5 'very high'). The results reveal that most respondents agreed that its level is below average (2.59). Therefore, much improvement is needed to increase the level of logistics in Iranian seaports. Moreover, it also highlighted the significance of this study in its development of a framework to effectively integrate port logistics functions and activities. The results of the descriptive analysis will help to reach the final conceptual framework and answer the third research question of this study. Thus, this section provides preliminary results for EFA and CFA sections.

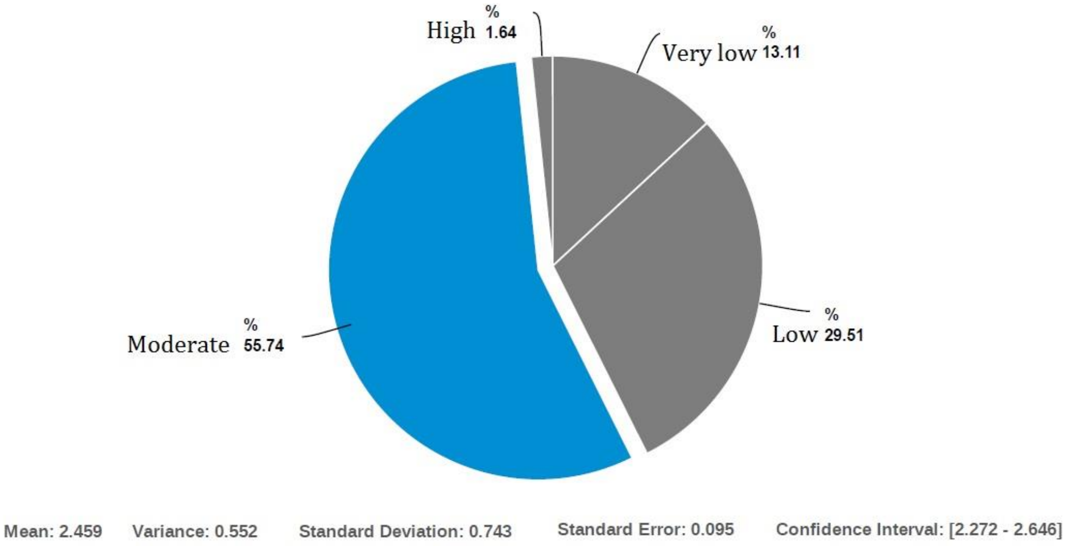



Figure 5.5. Level of port logistics integration in Iranian seaports

## 5.6. EXPLORATORY FACTOR ANALYSIS: INFLUENTIAL FACTORS OF PORT LOGISTICS INTEGRATION

This section presents the result of exploratory factor analysis (EFA) and is followed by the results of confirmatory factor analysis (CFA) in Section 5.7. EFA was conducted to identify the influential, underlying factors of port logistics integration from the survey questions, particularly in the second and third sections. To statistically test the relationship between factors, CFA was subsequently carried out. This process was also applied for logistics integration challenges in Iranian seaports.

EFA can be used as a tool to uncover the underlying structure of a relatively large set of observed variables without imposing a predefined structure on the result (Sakalayen 2014a). Therefore, EFA was first used to evaluate the main conceptual framework and logistics challenges in Iranian seaports.

### 5.6.1. Data sample adequacy

Before commencing EFA, the data sample needs to be tested for its suitability for this type of analysis (Williams *et al.* 2010; Costello *et al.* 2011; Baglin 2014). First, it is important to ensure that the sample size is sufficient for EFA. The ratio of the number of observations to the number of variables is useful for checking and ensuring the sample size is sufficiently large for EFA and CFA.  Several studies suggest different rules of thumb for adequate sample size which varies between 100 to more than 1,000. A number of researchers have recommended that above 200 responses are enough for factor analysis (Hair *et al.* 1998; Pallant & Manual 2010; Williams *et al.* 2010). In this study, 212 questionnaires have been collected which is deemed sufficient by numerous scholars. On the other hand, some researchers believe that sample to variable ratio can provide better guidance regarding the required participants for each variable. According to a study by Williams *et al.* (2010), the minimum acceptable range for factor analysis is the ratio 3:1. The ratio for this study is about 4:1 or 5:1, which is in an acceptable range.

Second, it is also necessary to carry out Bartlett's test of sphericity before conducting EFA. Bartlett's Test of Sphericity is the test for a null hypothesis, determining whether the correlation matrix has an identity matrix. Taking this into consideration, this test provides the minimum standard to proceed to factor analysis. The null hypothesis is the correlation matrix of the data set being an identity matrix, which means the data set is not sufficient for EFA. If the test statistic, the Chi-square statistic, is the p-value < 0.10, 0.05, 0.01, the null hypothesis is rejected at the 10 percent, 5 percent and 1 percent significance levels, respectively.

Third, the Kaiser-Mayer-Olkin (KMO) index is used to check for sampling adequacy of the data set. The KMO index varies from zero to 1. If the value is greater than 0.7, the correlations for the factor analysis are highly appropriate. Generally, values greater than 0.9 are marvellous, 0.8-0.9 are meritorious, 0.7-.08 are middling, 0.6-0.7 are mediocre, 0.5-0.6 are miserable and <0.5 are unacceptable (Kaiser & Rice 1974; Chipuer & Pretty 1999; Fanam 2016).

The preliminary analysis of data was conducted, illustrating that the data was strong enough for conducting factor analysis. After running the KMO and Bartlett's test, the following results were extracted from SPSS software. As it can be seen in Table 5.13, the KMO index was .840, which is above the recommended value (.70); indicating meritorious data adequacy. In addition, the Chi-square statistic of Bartlett's test of sphericity and its P value were 1529.286 and .000, respectively. Therefore, the null hypothesis is rejected at the 1 percent significance level.

Table 5.13. KMO and Bartlett's Test

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .866 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 1529.286 |
| | df | 325 |
| | Sig. | .000 |

In order to determine the number of factors, Kaiser's criterion and scree plot are used. According to Kaiser's criterion, a factor is retained if its eigenvalue is greater than 1. Cumulative percentage of variance is an area of incongruity in the factor analysis methods of different scholars, in different subjects such as humanities, social sciences and pure science (Henson & Roberts 2006). Although some proportions have been proposed, there is no fixed threshold. Based on a study by Hair *et al.* (1998), at least 95 percent of the variance needs to be explained in the natural sciences. In the social sciences, the explained variance is commonly as low as 50-60 percent (Hair *et al.* 1998; Pett *et al.* 2003; Williams *et al.* 2010).

### 5.6.2. Influential factors in port logistics integration

Different extraction methods exist for factor analysis, which varies according to the value and type of variance explained by the variables of each factor in the model. The most common method is the principal component method. In this method, the number of distinct principal components is equal to the number of original variables, but only factors that extrapolate the most variance are extracted (Richard & Dean 2007).

In Table 5.14, the first seven factors have the eigenvalue greater than one, from 6.911 to 1.013. The initial run produced seven components with eigenvalues greater than 1, explaining 26.580 percent, 6.160 percent, 5.552 percent, 5.164 percent, 4.859 percent, 4.445 percent and 3.895 percent of the variance respectively. These factors demonstrate a cumulative percentage of variance of 56.655 percent. This means that the 7 factors retained are capable of explaining 57 percent of variation of the variables. This could be due to the large number of variables (questions); there are 26 in total.

Table 5.14. PCA factor analysis of port logistics integration

| Component | Initial Eigenvalues | | | Rotation Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 6.911 | 26.580 | 26.580 | 2.489 | 9.572 | 9.572 |
| 2 | 1.602 | 6.160 | 32.740 | 2.361 | 9.079 | 18.651 |
| 3 | 1.443 | 5.552 | 38.291 | 2.094 | 8.053 | 26.704 |
| 4 | 1.343 | 5.164 | 43.455 | 2.034 | 7.823 | 34.527 |
| 5 | 1.263 | 4.859 | 48.314 | 1.987 | 7.641 | 42.167 |
| 6 | 1.156 | 4.445 | 52.759 | 1.954 | 7.515 | 49.683 |
| 7 | 1.013 | 3.895 | 56.655 | 1.813 | 6.972 | 56.655 |
| 8 | .991 | 3.812 | 60.467 | | | |
| . | . | . | . | | | |
| . | . | . | . | | | |
| 26 | .303 | 1.164 | 100.000 | | | |

Table 5.15 presents the Rotated Component Matrix and shows how multiple variables are associated with the seven factors identified. The first factor refers to ‘resource sharing’ (RS) which is associated with factors covered in questions RS1 to RS5 including design and joint development of packaging (.679), searching optimisation in the procurement (.658), searching for optimal subcontracting (.656), and shared use of containers to facilitate handling operations (.520). Based on the results, packaging appears to be the most important element of sharing resources between logistics partners in the port logistics chain. In could also be inferred that packaging is considered a crucial factor in 3PL (third party logistics), 4PL and 5PL which require logistics chain actors to use packaging and repackaging strategies to increase the level of logistics integration (Aguezzoul 2014).

The second factor refers to ‘institutional support’ (IS) which is associated with factors covered in questions IS1 to IS7 including business loans/microcredit facilities (.771) facilitating leases (.676), financial support for logistics providers (.675), and identify and implement the best practices in freight transport (.600). Results of the EFA for this factor shows that Loans, credits and leases are important for logistics chain partners and that connecting with financial institutions is more valuable than governmental and educational initiations for them. The respondents believe that local and international financial institutions, such as banks, could assist logistics distribution more effectively by introducing efficient financial services (Pinmanee 2016).

The third factor refers to 'organisational activities' (OA) which is associated with factors covered in questions OA1 to OA6 including teamwork for placing a new employee into an existing team (.686), encouraging teamwork for work in diverse situation (.676), keeping the interests of all stakeholders in mind (.582), and joint search for end-customer satisfaction (.353). The result for the first factor implies that using teamwork strategies in existing teams and in diverse situations is a greatly important aspect of organisational activities in the port logistics integration context. Teamwork along the cross-functional teams and supply chains would result in organisational success and supply chain integration (Lummus *et al.* (2008). In addition, it is crucial to have customers' and stockholders' interests in mind to have a successful logistics chain.

The fourth factor refers to 'value added services' (VAS) which is associated with factors covered in questions VAS1 to VAS7 including value-added logistics storage equipment.) 677(, making quick decisions regarding changing design processes (.598) involving the partners in the development process (.527) and adequate facilities for adding value to cargoes (.518). The results indicate that the significance of these value-added attributes is to be assessed by different domain perspectives through utilising storage equipment. Moreover, focusing on design and development processes as well as providing adequate facilities and infrastructures are essential in each port to increase its level of logistics integration in terms of its value-added activities.

The fifth factor refers to 'process and operation' (PO) which is associated with questions PO1 to PO8. These questions refer to modal shifts among different modes of transportation (.697), joint transport planning, management and control processes (.561) and make a contract with partners for a quality service level (.545). The process and operation factor is the most visible and practical part of logistics integration. Based on the EFA results, suitable connections with trucking companies, regarded as critical nodes in the offshore part of port logistics integration, is the most important item in the process and operation factor. Furthermore, it is advisable that quality standards are used for the whole logistics chain to ensure its partners are using the same level of quality in their processes and operations.

The sixth factor, 'logistics practices' (LP) is associated with questions LP1 to LP7. These questions refer to the identification of transport modes (.798), identifying least-cost options for transport (.744), evaluating alternative routes (.442) and integrated promotion activities for the port (.410). Based on the results, it can be inferred that planning and designing the right plan for using the right mode for each link and optimisation of this link is the most important factor in logistics practices. What's more, the respondents seem to think that cost management, assessing different routes as well as applying promotion activities can better describe logistics practices.

The last factor, 'information and communication integration' (II) is associated with questions II1 to II9, which concern the use of an online transaction with partners (.792), using advanced IT to book space for containers (.691), and adopting electronic data interchange (EDI) (.532). This factor is traditionally considered one of the most important aspects of logistic integration due to its important impact on the coordination and integration of different partners in the logistics chain. The implementation stage of information integration can differ in different parts of the world. Based on the results of the Iranian experts, website transactions with partners plays the most important role in the integration process of information. In addition, in the Iranian case, using advanced IT to book space for containers and using EDI systems can play a significant role in increasing the level of information integration.

In order to test the reliability, Cronbach's alpha has been used which is recommended by many researchers, such as Bonett and Wright (2015) and Saunders *et al.* (2012), as a popular test of reliability. In other words, if you use the same questionnaire once again with the sample, similar results will be derived. The results of the reliability test can be seen in the last row of Table 5.15. Some researchers consider 0.6 as the cut-off point and an acceptable range for reliability test speciality when the scale has two or three items (Hair *et al.* 1998; Loewenthal 2001; Mahlangu & Kruger 2015).

Although the reliability scores (Cronbach's alpha) below are the most commonly suggested level in the literature, we can argue that these scores were satisfactory in similar studies (Panayides & Song 2008; Song & Panayides 2008; Uusipaavalniemi & Juga 2008; Bichou 2009; Panayides & Song 2009; Cai *et al.* 2010; Han *et al.* 2013; Adams *et al.* 2014). Moreover, as Cronbach's alpha is related to the number of questions for each factor, specifically when the number of questions is below 10 items, it is not uncommon to have the Alpha coefficient below 0.7 (Pallant 2010). According to Bernardi (1994), low levels of Cronbach's alpha can be owing to the sample homogeneity, large number of questions and other specific reasons; thus; not always sufficient to bring the results into question.

Table 5.15. Rotated Component Matrix[a]

| | | Component | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Items | | Resource sharing | Institutional support | Organisational activities | Value-added services | Process and operations | Logistics practices | Information integration |
| RS3 | Joint development of packaging | .679 | | | | | | |
| RS5 | Searching for optimisation in the procurement | .658 | | | | | | |
| RS2 | Searching for optimal subcontracting | .656 | | | | | | |
| RS4 | Involving actors in decision making | .520 | | | | | | |
| IS3 | Approving business loans facilities | | .771 | | | | | |
| IS4 | Facilitating leases | | .676 | | | | | |
| IS2 | Financial support for logistics providers | | .675 | | | | | |
| IS1 | Identify best practices in freight transport | | .600 | | | | | |
| OA6 | Teamwork for placing a new employee | | | .686 | | | | |
| OA5 | Teamwork for work in diverse situations | | | .676 | | | | |
| OA4 | keeping the interests of all stakeholders | | | .582 | | | | |
| VAS2 | Value-added logistics storage equipment | | | | .677 | | | |
| VAS7 | Quick decisions for changing design processes | | | | .598 | | | |
| VAS4 | Involving partners in the development process | | | | .527 | | | |
| VAS1 | Adequate facilities for adding value to cargoes | | | | .518 | | | |
| PO1 | Level of modal shift among different modes of transportation | | | | | .697 | | |
| PO4 | Joint transport planning and control processes | | | | | .561 | | |
| PO5 | contract for a quality service levels (partners) | | | | | .545 | | |
| LP5 | Identify transport modes for linking port | | | | | | .798 | |
| LP4 | Identifying least-cost options for transport | | | | | | .744 | |
| LP1 | Evaluating alternative routes | | | | | | .442 | |
| II8 | High level of website transaction with partners | | | | | | | .792 |
| II5 | Advanced IT to book space for containers | | | | | | | .691 |
| II9 | Adopting electronic data interchange (EDI) | | | | | | | .532 |
| | **Reliability** | .710 | .754 | .695 | .603 | .608 | .662 | .606 |

[a] Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalisation.

## 5.7. Confirmatory factor analysis: influential factors of port logistics integration

Confirmatory factor analysis (CFA) is one of the techniques used to determine the dimensions of the underlying measurement of indicators; that is, the relationships between observed measures or indicators (such as behavioural observation ratings and test scores) and latent variables (Brown & Moore 2012; Adachi 2016). In this way, the relationship between the factors and the variables is evaluated so that the theoretical constructs can be verified empirically. As shown in Hartono *et al.* (2014), CFA has two main categories: First-order Verifiability Factor and Second-factor Confirmation Factor. In the first-order confirmation factor analysis, the relationship between the latent variables and observable variables is measured. In this method, no relationship between latent variables is measured. This type of measurement model simply ensures that the latent variables are properly measured. When a large structure consists of several latent variables, second-order confirmation factor analysis is used. In the second-order verification factor analysis, in addition to examining the relationship between observable variables and latent variables, the relationship between latent variables and their original constructs is also examined (Habibi 2017).

Before proceeding with the results of CFA, it is advisable to review the model fit and indices to make sure the final model is fit and reliable based on the proposed framework. In other words, prior to starting the analysis, the researcher should answer this question: to what extent is the developed model based on the theoretical framework, and the empirical background consistent with reality? The researcher expects the fitting of data to the model to be acceptable in his research based on scientific criteria. The CFA in this study began with various model fit indices. In this study, CFA was conducted using AMOS software version 22, which is based on the SPSS platform (also used in CFA in the previous section). As mentioned in Chapter 4 (see Section 4.8.1), there are more than 30 model fit indexes computed by AMOS software. Analysing and interpreting all these indexes would be confusing. Cangur and Ercan (2015) suggest Root Mean Squared Error of Approximation (RMSEA), Normed Chi-Square (CMIN/DF) and Comparative fit index (CFI) as the most important indicators of model fit.

Table 5.16. The acceptable level for CFA fit indexes

| Measure | Threshold |
|---|---|
| CMIN/DF | ≤ 3good; <5 Permissible |
| P-Value | > 0.05 |
| RMSEA | < 0.05 good; 0.05- 0.10 moderate; > 0.10 bad |
| PCLOSE | > 0.05 |
| IFI | > 0.90 |
| CFI | > 0.95 great; > 0.90 traditional; > 0.80 permissible |
| NFI | > 0.90 |
| GFI | > 0.90 good; > 0.80 tolerable |
| AGFI | > 0.90; > 0.70- 0.80 tolerable |
| Source: (Kelloway 1998; Hu & Bentler 1999; Schumacker & Lomax 2004; Hooper *et al.* 2008; Blunch 2012; Ghasemi 2014; Byrne 2016) | |

In order to further evaluate the proposed model which has been analysed through exploratory factor analysis and its underlying factors, confirmatory factor analysis is applied. The results of the CFA and EFA analyses will help to answer the second research question concerning the critical factors in logistics integration from the Iranian ports' perspective. In Section 5.6 on EFA, critical factors have been identified and selected from a large number of factors. Meanwhile, in Section 5.7, CFA allows the researcher to test the hypothesis that a relationship exists between the observed variables and their underlying latent constructs. Figure 5.6 shows standard estimates of the correlation coefficient for each latent variable and its items and the relationship between underlying factors. In terms of the relationship between underlying factors, all covariances are indicated as strong relationships (above 0.5, except the relationship between Information integration and resource sharing). For example, the relationships between value-added services and process and operation; resource sharing and organisational activities; logistics practices and organisational activities are considered as highly related factors (all above 0.7). Table 5.17 indicates the standardised regression weights for the default model. This table strongly indicates that all relationships are significant at 1 percent, which ranges from 0.425 to 0.767, and also shows the estimated coefficient for each item.

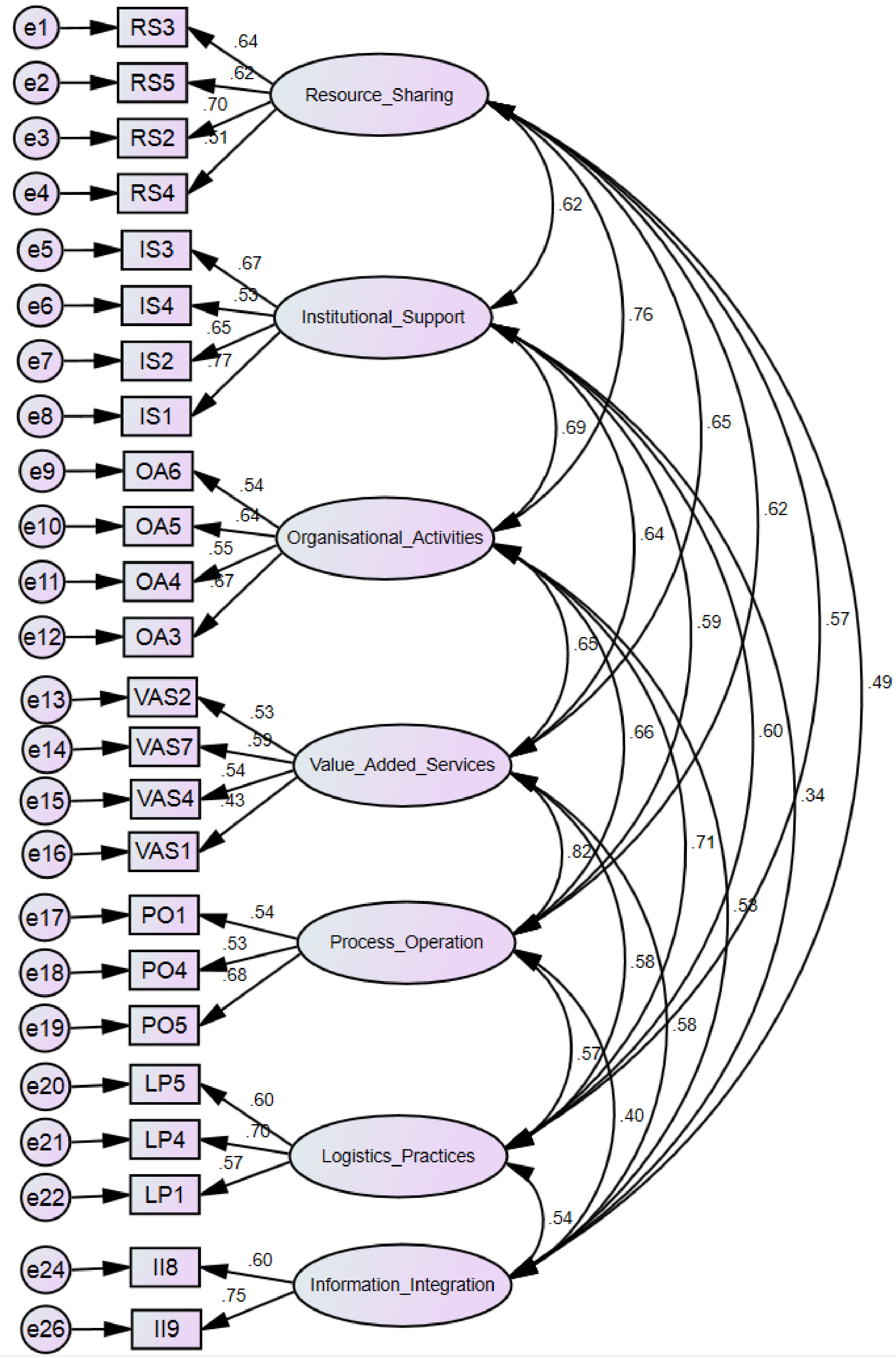



Figure 5.6. Path diagram with standardised estimates for port logistics integration

Table 5.17. Standardised Regression Weights Default model

| Variable | | | Factors | Estimate | P |
|---|---|---|---|---|---|
| **RS4** | Joint development of packaging | <--- | RS | .507 | *** |
| **RS2** | Searching for optimisation in the procurement | <--- | RS | .699 | *** |
| **RS5** | Searching for optimal subcontracting | <--- | RS | .624 | *** |
| **RS3** | Involving actors in decision making | <--- | RS | .641 | .004 |
| **IS1** | Approving business loans facilities | <--- | IS | .767 | *** |
| **IS2** | Facilitating leases | <--- | IS | .652 | *** |
| **IS4** | Financial support for logistics providers | <--- | IS | .536 | *** |
| **IS3** | Identify best practices in freight transport | <--- | IS | .673 | *** |
| **OA3** | Teamwork for placing a new employee | <--- | OA | .667 | *** |
| **OA4** | Teamwork for work in diverse situations | <--- | OA | .548 | *** |
| **OA5** | Keeping the interests of all stakeholders | <--- | OA | .645 | *** |
| **OA6** | Joint search for end-customer satisfaction | <--- | OA | .539 | *** |
| **VAS1** | Value-added logistics storage equipment | <--- | VAS | .432 | *** |
| **VAS4** | Quick decisions for changing design processes | <--- | VAS | .548 | *** |
| **VAS7** | Involving partners in the development process | <--- | VAS | .582 | *** |
| **VAS2** | Adequate facilities for adding value to cargoes | <--- | VAS | .534 | *** |
| **PO5** | Level of modal shift among different modes of transportation | <--- | PO | .676 | *** |
| **PO4** | Joint transport planning and control processes | <--- | PO | .538 | *** |
| **PO1** | the contract for a quality service levels (partners) | <--- | PO | .533 | *** |
| **LP1** | Evaluating alternative routes | <--- | LP | .557 | *** |
| **LP4** | Identifying least-cost options for transport | <--- | LP | .692 | *** |
| **LP5** | Identifying transport modes for linking seaports to hinterland | <--- | LP | .592 | *** |
| **II9** | High level of website transaction with partners | <--- | II | .645 | *** |
| **II8** | Adopting electronic data interchange (EDI) | <--- | II | .700 | *** |

*** = significant at 1% significance level

Table 5.18 shows the model fit indices for critical factors of port logistics integration. The results in the first table indicate that CMIN/DF is 1.266 and considered in a good range, while the P-value (0.002) shows the model is significant. Given AGFI and GFI point estimate .861 and .890 respectively, and other indices associated with the Absolute Fit indices, it can be concluded that the resulting model has a good fit. With regards to comparative fit indices such as NFI, IFI, TLI and CFI (which is 0.78, 0.944, 0.932 and 0.942 respectively), it evident that indices are in the acceptable level - with the exception of the coefficient for NFI which is only close to the acceptable range. Therefore, it is clear that the model is in good fit based on comparative fit indices. Furthermore, the coefficient for RMSEA and PCLOSE are 0.038 and 0.988 respectively, and it shows that they can be considered in the acceptable range.

Considering the aforementioned fit indices, it can be concluded that the resultant model fits the data well.

Table 5.18. Model fit summery

**CMIN**

| Model | NPAR | CMIN | DF | P | CMIN/DF |
|---|---|---|---|---|---|
| Default model | 73 | 352.010 | 278 | .002 | 1.266 |
| Saturated model | 351 | .000 | 0 | | |
| Independence model | 26 | 1601.387 | 325 | .000 | 4.927 |

**RMR, GFI**

| Model | RMR | GFI | AGFI | PGFI |
|---|---|---|---|---|
| Default model | .028 | .890 | .861 | .705 |
| Saturated model | .000 | 1.000 | | |
| Independence model | .131 | .396 | .348 | .367 |

**Baseline Comparisons**

| Model | NFI Delta1 | RFI rho1 | IFI Delta2 | TLI rho2 | CFI |
|---|---|---|---|---|---|
| Default model | .780 | .743 | .944 | .932 | .942 |
| Saturated model | 1.000 | | 1.000 | | 1.000 |
| Independence model | .000 | .000 | .000 | .000 | .000 |

**RMSEA**

| Model | RMSEA | LO 90 | HI 90 | PCLOSE |
|---|---|---|---|---|
| Default model | .036 | .023 | .046 | .988 |
| Independence model | .136 | .130 | .143 | .000 |

After conducting EFA and CFA for port logistics integration, we are able to answer the second research question regarding the critical factors in logistics integration from the Iranian ports' perspective. According to the results, EFA identified seven critical factors, which is aligned with the findings noted within the literature review. However, some items were rejected or were not applicable to the Iranian port logistics system. This result suggests that EFA output was similar to the CFA results, producing a model of seven factors that are influential on port logistics integration: resource sharing, organisational activities, institutional support, information and communication integration, value-added services, processes and operations and logistics practices. One of the important results of the CFA is the strong relationship between identified factors, which shows the framework is strong enough in terms of its identified factors. More importantly, three factors have not been measured specifically in previous studies and their role was not clear among the critical factors of port logistics integration. Hence, the results of this study introduce and examines these critical factors of port logistics integration within the Iranian port logistics system.

## 5.8. Exploratory Factor Analysis of the Challenges in Iranian Port Logistics Integration

As established in Section 5.6.2, a preliminary analysis showed that the data was strong enough for conducting factor analysis. The results of the KMO and Bartlett's test for challenges in Iranian seaports were extracted using SPSS software. As illustrated in Table 5.19, the KMO index was 0.719, which is above the recommended value (0.70), indicative of middling data adequacy. Moreover, the Chi-square statistic of Bartlett's test of sphericity and its significance were 455.495 and 0.000 respectively. Therefore, the null hypothesis is rejected, showing that the variables are correlated.

Table 5.19. KMO and Bartlett's Test

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .711 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 414.090 |
| | Df | 55 |
| | Sig. | .000 |

Table 5.20 presents the total variance explained and in particular, the total column provides the amount of variance in the original variables or the eigenvalue for each component. The percentage of variance column provides the ratio, expressed as a percentage, of the variance accounted for each component. The cumulative percentage column gives the percentage of variance accounted for by the first n components. What's more, an initial run of the four components elicited an eigenvalue greater than one, from 3.105 to 1.087. The identified components explaining 25.874 percent, 13.562 percent, 10.184 percent and 9.061 percent of the variance respectively. These factors demonstrate a cumulative percentage of variance of 58.680 percent. Thus, these four factors are in the common range of explained variances based on Kaiser's criterion (Nguyen 2013b).

Table 5.20. PCA factor analysis of challenges in Iranian port logistics integration

| | Initial Eigenvalues | | | Rotation Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| Component | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 2.954 | 26.853 | 26.853 | 2.217 | 20.154 | 20.154 |
| 2 | 1.584 | 14.398 | 41.252 | 1.691 | 15.371 | 35.526 |
| 3 | 1.204 | 10.944 | 52.195 | 1.459 | 13.263 | 48.789 |
| 4 | 1.079 | 9.805 | 62.000 | 1.453 | 13.212 | 62.000 |
| 5 | .796 | 7.240 | 69.240 | | | |
| 6 | .751 | 6.825 | 76.066 | | | |
| 7 | .654 | 5.949 | 82.015 | | | |
| 8 | .585 | 5.320 | 87.335 | | | |
| 9 | .540 | 4.911 | 92.246 | | | |
| 10 | .479 | 4.350 | 96.596 | | | |
| 11 | .374 | 3.404 | 100.000 | | | |
| 12 | 2.954 | 26.853 | 26.853 | | | |

The findings in the literature review section indicate that the challenges can be categorised into five factors. However, factor analysis results show that challenges in the Iranian port logistics integration are associated with four factors. Thus, the "Governance and policy" factor has not been identified as a challenge in Iranian port logistics. The first factor refers to 'sanctions' (SA) which is associated with factors covered in questions SA1 to SA4 including international economic sanctions (0.745), problems with investment and securing financial credit (0.778), problems with financial transactions (0.765) and financial institutions unwillingness to invest (0.620). The items under this factor are mostly related to economic and financial impacts of international sanctions on the Iranian economy and more specifically the Iranian port industry, which impeded interactions with logistics chain members outside of Iranian borders. Consequently, the factor is labelled 'sanctions'.

The second factor refers to 'operational/technical' (OT) which is associated with factors covered in questions OT1 to OT6 including high terminal charges (0.755), poor freight distribution systems (0.723) and lack of coordination in port activities (0.695). The items under this factor are related to process and operational and logistics practice problems which are mentioned in the port logistics integration conceptual framework. Expensive terminal charges in Iranian seaports compared to neighbouring countries (e.g. UAE and Oman), using underdeveloped freight distribution facilities and inadequate coordination activities with partners in seaports were inferred from the factor analysis results.

The third factor refers to 'Infrastructure' (IN) which is associated with factors covered in questions IN1 to IN3 including lack of appropriate infrastructure in ports logistics and transportation systems (0.795) and insufficient investment in ports (0.824). The items under this factor are largely related to three factors in port logistics integration framework: organisational activities, resource sharing and institutional support. As identified in Section 5.6.2 on value added services, infrastructural issues are one of the most significant areas needing improvement. Most of the participants believed that a lack of investment and underdeveloped resources are among the two most important infrastructural issues.

The fourth factor refers to 'managerial/organisational' (MO) which is associated with factors covered in questions MO1 to MO4 including  poor customer relationship management (.811 (and shortage of skilled human resources.) 808 .(The items under this factor are chiefly related to organisational activities in the PLI framework. This factor examines intra-organisational and inter-organisational issues in the Iranian port logistics chain. However, the identified factors mostly concern intra-organisational activities, such as human resource management and customer relationship management, meaning that these areas are top priority to change and improve.

To test the reliability of the four factors, Cronbach's alpha has been used similarly to the PLI framework. The results of the reliability test can be seen in the last row of Table 5.21. All reliability coefficients are above 0.6. The reliability coefficient for sanctions, operational/technical, infrastructure and managerial/organisational factors are 0.723, 0.611, 0.608 and 0.625 respectively. Therefore, it can be inferred that all four factors are considered as reliable factors.

Table 5.21. Rotated Component Matrix[a]

| | Items | Sanctions | Operational/ Technical | Infrastructure | Managerial/ Organisational |
|---|---|---|---|---|---|
| SA3 | Problems with investment and securing financial credit | .778 | | | |
| SA2 | Problems with financial transactions in import and export | .765 | | | |
| SA1 | Economic international sanctions | .745 | | | |
| SA4 | Financial institutions unwillingness to invest | .620 | | | |
| OT4 | High terminal charges | | .755 | | |
| OT3 | Poor freight distribution systems | | .723 | | |
| OT5 | Lack of coordination in port activities | | .695 | | |
| IN2 | Lack of appropriate infrastructure | | | .795 | |
| IN1 | Insufficient investment in ports | | | .824 | |
| MO3 | Poor customer relationship management | | | | .811 |
| MO4 | Shortage of skilled human resources | | | | .808 |
| Reliability | | .723 | .611 | .608 | .625 |

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

## 5.9. Confirmatory Factor Analysis of the Challenges in Iranian Port Logistics Integration

The results of the initial CFA were acceptable based on its model fit indices. However, in order to reach a strong model, some modifications have been made. Figure 5.7 illustrates the standard estimates of the correlation coefficient for each latent variable and its items and the relationship between underlying factors. The relationship between four identified factors can be considered as moderate to weak. The relationship between infrastructure and managerial/ organisational, and operational/technical and managerial/organisational are 0.47 and 0.42 respectively, which is a moderate correlation. Furthermore, the relationship between other factors such as infrastructure and operational/technical, sanctions and infrastructure, operational/technical and sanctions, and managerial/organisational and sanctions are 0.37, 0.31, 0.34 and 0.38 respectively which are considered weak covariance coefficients.

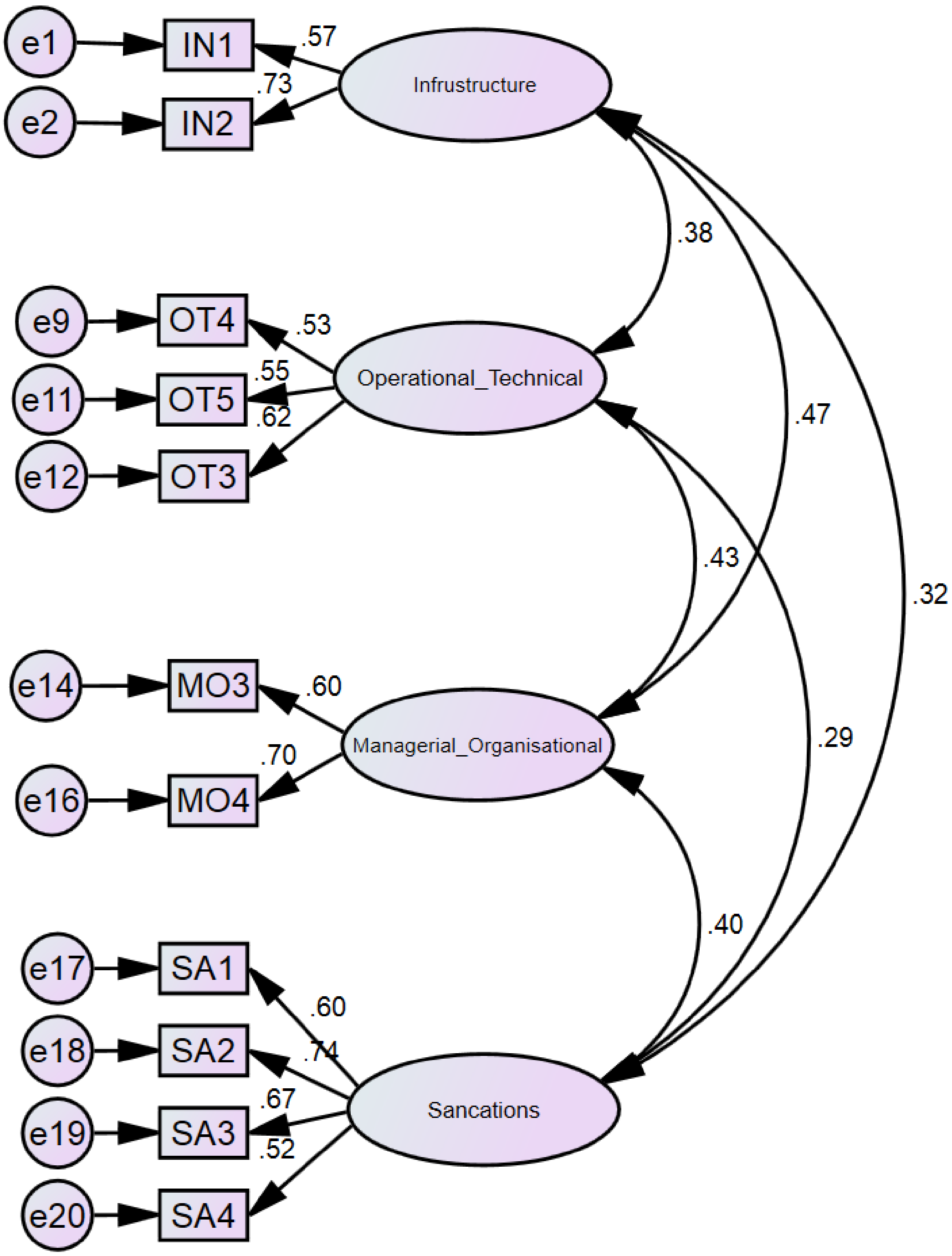



Figure 5.7. Path diagram with standardised estimates for challenges in Iranian port logistics integration

Table 5.22 indicates standardised regression weights for the default model. The standardised regression weights and the correlations are independent of the units in which all variables are measured; therefore, they are not affected by the choice of identification constraints. This table strongly indicates that all relationships are significant at 1 percent, ranging between 0.541 to 0.864, and shows the estimated coefficient for each item.

Table 5.22. Standardised Regression Weights Default model

| | ITEMS | | | ESTIMATE | S.E. | C.R. | P |
|---|---|---|---|---|---|---|---|
| IN1 | Insufficient investment in ports | <--- | IN | .564 | .039 | 2.570 | *** |
| IN2 | Lack of appropriate infrastructure in ports logistics and transportation systems | <--- | IN | .734 | .048 | 3.116 | *** |
| OT4 | High terminal charges | <--- | OT | .545 | .035 | 2.738 | *** |
| OT5 | Lack of coordination in port activities | <--- | OT | .541 | .040 | 3.124 | *** |
| OT3 | Poor freight distribution systems | <--- | OT | .619 | .032 | 3.073 | *** |
| MO4 | Shortage of skilled human resources | <--- | MO | .713 | .036 | 3.543 | *** |
| MO3 | Poor customer relationship management | <--- | MO | .593 | .052 | -3.599 | *** |
| SA4 | Unwillingness of financial institutions and credit institutions to invest | <--- | SA | .675 | S.E. | C.R. | *** |
| SA3 | Problems with investment and securing financial credit | <--- | SA | .591 | .039 | 2.570 | *** |
| SA2 | Problems with Financial transactions in import and export | <--- | SA | .864 | .048 | 3.116 | *** |
| SA1 | International economic sanctions | <--- | SA | .540 | .035 | 2.738 | *** |

*** = significant at 1% significance level

Table 5.23 shows the model fit indices for the critical factors of port logistics integration. The results in the first table show that CMIN/DF is 1.141 and within a good range, while the P-value (0.006) shows the model is significant. Given AGFI and GFI point estimate 0.939 and 0.966 respectively, and other indices associated with the Absolute Fit indices, it can be concluded that the resulting model has an excellent fit. With regards to comparative fit indices such as NFI, IFI, TLI and CFI (which is 0.900, 0.987, 0.979 and .986 respectively) it can be seen that indices are in the acceptable level and can be considered as an excellent model fit index. Therefore, it is clear that the model is in good fit based on comparative fit indices. Furthermore, the coefficient for RMSEA and PCLOSE are 0.026 and 0.884 respectively, and it shows that they can be considered in the acceptable range. Hence, it can be concluded that the resultant model fits the data well.

Table 5.23. Model fit summery

**CMIN**

| Model | NPAR | CMIN | DF | P | CMIN/DF |
|---|---|---|---|---|---|
| Default model | 29 | 42.209 | 37 | .006 | 1.141 |
| Saturated model | 66 | .000 | 0 | | |
| Independence model | 11 | 423.114 | 55 | .000 | 7.693 |

**RMR, GFI**

| Model | RMR | GFI | AGFI | PGFI |
|---|---|---|---|---|
| Default model | .032 | .966 | .939 | .542 |
| Saturated model | .000 | 1.000 | | |
| Independence model | .147 | .668 | .601 | .556 |

**Baseline Comparisons**

| Model | NFI Delta1 | RFI rho1 | IFI Delta2 | TLI rho2 | CFI |
|---|---|---|---|---|---|
| Default model | .900 | .852 | .987 | .979 | .986 |
| Saturated model | 1.000 | | 1.000 | | 1.000 |
| Independence model | .000 | .000 | .000 | .000 | .000 |

**RMSEA**

| Model | RMSEA | LO 90 | HI 90 | PCLOSE |
|---|---|---|---|---|
| Default model | .026 | .000 | .057 | .884 |
| Independence model | .178 | .162 | .194 | .000 |

After conducting EFA and CFA for challenges in Iranian port logistics integration, we are able to answer the third research question regarding the challenges facing Iranian port logistics integration. According to the results, EFA identified four critical factors, running in contrast to the findings of past studies. In our literature review, five factors have been identified and, with the exception of the governance and policy factor, four new factors have been accepted after EFA. However, some items were rejected or were not applicable to the Iranian port logistics system. The final results of the EFA indicate that 'impact of the global economic crisis on Iranian shipping' can be considered as one of the sanction items. Having said that, the results of the CFA exclude this item. Thus, the ‘governance and policy’ factor was totally rejected by Iranian participants’ perspective. This result suggests that EFA and CFA outputs produce a model with four factors: sanctions, operational/technical, infrastructure and managerial/organisational. One of the significant contributions of these analyses is identifying the challenges of port logistics integration, which has not been explicitly investigated in the port sector. More importantly, the next stage of qualitative data analysis and examining open-ended questions will identify more issues and challenges in the Iranian context. In addition, using both qualitative and quantitative analyses will provide a strong and reliable view of port logistics integration in the Iranian context.

## 5.10. SUMMARY

This chapter presented the results of the quantitative analysis that seeks to answer the second subsidiary research question (SRQ2) and part of the third subsidiary research question (SRQ3) concerning critical factors in logistics integration, the challenges facing Iranian port logistics integration.

The first part of this chapter presents a summary of the data collection process and how data for this study was gathered using self-administrative and online data collection methods. Then the response rate and data validation for both methods were reviewed. This chapter presents the results of a survey of 212 port officials in Iranian seaports and their associations (internal port stakeholders) as well as other experts in various actors with the response rate of 50 percent. As indicated by the survey results, around 45 percent of respondents have knowledge of port management. Around 92 percent of respondents had been on the job for more than 6 years, showing that respondents had considerable experience and professional knowledge in the maritime logistics sector. Around 37 percent of respondents held senior expert positions and around 44 percent of participants were familiar with Rajaee and Imam Khomeini seaports, two notable seaports in Iran that handle more than 70 percent of the country’s imports and exports.

The results of the EFA indicate that the influential factors of port logistics integration concern resource sharing, organisational activities, institutional support, information and communication integration, value-added services, processes and operations and logistics practices. The results of the CFA confirm the effect of these underlying influential factors with some changes in items. On the other hand, the results of the EFA and CFA for challenges in Iranian port logistics integration indicate four challenging factors which encompass sanctions, operational/technical, infrastructure and managerial/organisational.

In the next chapter, the qualitative data analysis results will be discussed to answer the third research question. The results of the EFA and CFA will be discussed in more detail in Chapter 7.

# CHAPTER 6: QUALITATIVE DATA ANALYSIS

## 6.1. INTRODUCTION

Following the previous chapter on quantitative analysis, this chapter considers the challenges of port logistics integration in Iranian seaports, which relates to the fourth section of the questionnaire. As discussed in Chapter 5, five challenging areas of port logistics integration have been identified through the literature review process. The results of the factor analysis approved four factors. To obtain deeper insights into the challenges of port logistics integration, open-ended questions have been specifically designed. The qualitative section also aims to answer the third secondary research question:

> SRQ3. What are the challenges facing Iranian port logistics integration?

To answer the research question, this chapter strives to provide an in-depth understanding of the challenges and future opportunities in Iranian seaports using five open-ended questions. Open-ended questions are used to allow participants to articulate their own ideas which may not be already represented in the extant literature especially the challenges related to infrastructural, management and organisational, and information integration issues. It is also important to investigate the respondents' solutions and recommendations in order to overcome these challenges.

Section 6.2 provides information about the qualitative data sample. Section 6.3 explains the content analysis procedure. Section 6.4 review the qualitative data set and validity check. Section 6.5 briefly focuses on each question to uncover and gain insight into what lies behind the challenges in the port sector and explores the findings of the qualitative data through NVivo analysis tools. Finally, section 6.6 summarises the major results of the qualitative information and confirms whether the proposed underpinning theoretical argument is valid or the extent to which it is not.

## 6.2. QUALITATIVE DATA SAMPLE

As mentioned earlier in chapter 4, the fourth section was related to open-ended questions and qualitative data. These data have been collected through both an online survey and self-administrative survey (paper-based). Among the 212 collected questionnaires, 105 respondents answered the open-ended questions, garnering a 49 percent response rate for the qualitative section. Among participants who filled out the open-ended questions, 33 percent were from port authorities, 18 percent from the terminal, 28 percent from shipping companies, 9 percent from logistics/ freight forwarding companies, 7 percent from import and export companies and 5 percent from other logistics partners. According to these statistics, most of the suggestions came from external logistics chain partners. Hence, it may be construed that these parties can more clearly detect the present systemic challenges than the people working in the focal firm (PMO).

The data sample comprises 78 percent of participants with more than 10 years of experience. In terms of participants' positions, around 64 percent of qualitative respondents held different management positions. Therefore, the answers are mostly based on a managerial perspective to issues and challenges. In terms of the location of the participants, Rajaee and Imam Khomeini ports comprise more than 40 percent of the qualitative sample, which is almost the same as the quantitative data sample.

## 6.3. CONTENT ANALYSIS

Content analysis is "a systematic and objective means of describing and quantifying phenomena" (Elo & Kyngäs 2008). There are two main types of content analysis: deductive and inductive approaches. The deductive analysis is used when the aim of the study is to test a framework or theory and the study is formulated based on previous literature and knowledge (Lauri & Kyngas 2005). The inductive approach is used when there is not enough knowledge and literature in that specific area or the knowledge is fragmented. Therefore, based on the characteristics and structure of the study, it is more suitable to use an inductive approach (Elo & Kyngäs 2008). The general fractures of data analysis methods can be tied to classifying the whole content into much smaller content groups (Burnard 1996).

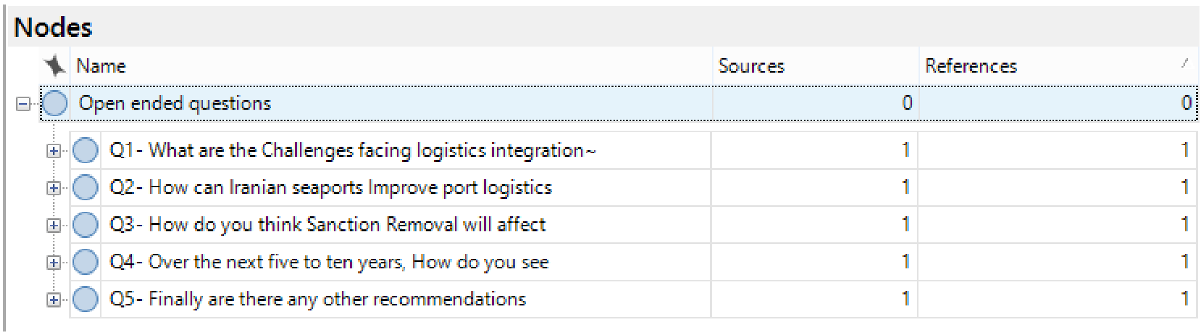
The content analysis procedure can be categorised into three steps: preparation, organising and reporting (Elo & Kyngäs 2008). The preparation stage begins with choosing a unit of analysis, which is denoted as the major unit or entity (i.e. 'what' or 'who') that is being analysed in the study (Babbie 2015). Based on a study by Graneheim and Lundman (2004), unit of analysis refers to a great diversity of research objects such as a program, classroom or clinic, person, organisation, community, state or nation, set of interviews or diary collection. Every word or phrase is written in the transcript, or parts of the text that are abstracted and coded can be considered as a unit of analysis. In this study, transcripts of opened-ended questions will be considered as a unit of analysis.

After the preparation phase, the organising stage (data analysis) is conducted using the inductive approach. The analysis process encompasses three stages: open coding, creating categories and abstraction (Elo & Kyngäs 2008). After transferring all the collected answers in Microsoft Word, the process of open coding begins. In this stage, responses to open-ended questions are read thoroughly and all opinions, views and ideas mentioned by participants are recorded as notes, bullet points and headings – as many created as deemed necessary (Hsieh & Shannon 2005). After open coding, there are typically some recurring categories (i.e. mentioned one or two times), as well as some categories that are mostly agreed among respondents. Therefore, in order to avoid decentralisation and reporting outliers, it is recommended to group them under higher order headings (Burnard 1991). This also enables an easier comparison of the study's data with the existing literature and similar studies. Next, in the abstraction stage, each category is named using content-characteristics words. The process of enriching and summarising categories continues as far as reaching reasonable results.

## 6.4. The qualitative data set

Given a large volume of responses, it can be too complicated to review and code the data set manually. Therefore, using qualitative analysis tools such as NVivo, which has widely been used in qualitative studies, can help to speed up the data analysis and improve the accuracy (Creswell 2013). Once imported into NVivo, the data set needs to go through the Data tab and because the data is in a Microsoft Word file, the document should be selected. Imported data can be shown as internals as part of source items on the left-hand side of the NVivo program.

To answer the main question of the research, the responses for the qualitative section should be analysed. A general canvas of the data in the system reveals some similarities in how respondents describe their experiences and opinions. Every specific item can be assigned (coded) to categories (nodes). Nodes are like containers that can categorise the common data obtained from each answer, and codes are the specific items in responses that can be assigned in each category. Because the answers have been categorised by heading, NVivo can recognise them as separate nodes. In order to do this, the auto code option is used to categorise the open-ended question into nodes in which every selected column can represent each node. As a result, five main nodes are created as shown in Figure 6.1.



**Nodes**

| Name | Sources | References |
|---|---|---|
| Open ended questions | 0 | 0 |
| Q1- What are the Challenges facing logistics integration~ | 1 | 1 |
| Q2- How can Iranian seaports Improve port logistics | 1 | 1 |
| Q3- How do you think Sanction Removal will affect | 1 | 1 |
| Q4- Over the next five to ten years, How do you see | 1 | 1 |
| Q5- Finally are there any other recommendations | 1 | 1 |

Figure 6.1. Auto-coding results

Next, all statements made by respondents need to be coded accordingly with a title assigned to each sentence or phrase. To do this, the text should be highlighted and then right clicked to select “code selection” and then “…at new node”. Using “writing description” is very important because it can avoid misunderstandings and wrong coding.

To validate the data set, this study applies four methods:

- Checking the coding rules
- Face validity
- Checking the nodes using experts’ ideas
- Coding comparison

The first validity method involves well-defining coding roles. For the coding procedure, node descriptions have been written for each node. Node description can determine the scope of each node; that is, exactly what can be put into each node. In some cases, coding roles have been changed to wider or narrower descriptions to fit with texts. The second method concerns the structure; the words used for nodes, re-checking their descriptions, and making changes if necessary to make them clearer and easier to understand. During the third stage, memos have been used after validity to double check the changes had been added to selected nodes. After reviewing the nodes, it is useful to check if they need to be reorganised, i.e. combining, dividing into separate notes so as to gain better understanding and distinctions.

After coding the data, the coding comparison option (Query tab) has been selected, enabling the previous username to be compared with previous codes. Table 6.1 shows the results of the comparison matrix. The first column shows the node that contains the coding that is being compared. The second column indicates the Kappa coefficient. This coefficient is developed to measure the reliability using agreement percentage among those rating. It includes adding up the number of cases coded the same way (two raters) dividing by the total number of cases. However, this method doesn't count the number of agreements based on chance. In order to overcome this shortage, Cohen introduced a method named Cohen's Kappa which counts the proportion of units for which agreement is expected by chance. Kappa is calculated as:

$$k = \frac{P_A - P_C}{1 - P_C}$$

where:

- $P_A$ is the proportion of units on which the raters agree
- $P_C$ is the proportion of units for which agreement is expected by chance (Stemler 2001).

This coefficient shows the level of agreement between two sets of nodes by users. If the users are in complete agreement then the Kappa coefficient (K) = 1. If there is no agreement among the raters (other than what would be expected by chance), then the Kappa coefficient (K) ≤ 0. Coefficients greater than 0.7 are considered in an acceptable range (Wang *et al.* 2008; Ishak & Bakar 2012). A number of qualitative studies have used this method to check the reliability of their data (Stemler 2001; Eugenio & Glass 2004; Wang *et al.* 2008; Ishak & Bakar 2012).

Table 6.1. Kappa Coefficient Values and Interpretation

| **Kappa Value** | **Interpretation** |
|---|---|
| **Below 0.00** | Poor |
| **0.00-0.20** | Slight |
| **0.21-0.40** | Fair |
| **0.41-0.60** | Moderate |
| **0.61-0.80** | Substantial |
| **0.81-1.00** | Almost perfect |

The left three columns of Table 6.2 illustrate the agreement percentage. The green 'Agreement' column shows the sum of columns 'A and B' and 'not A and not B'. On the other hand, the red 'Disagreement' column indicates disagreement percentage between the first and second user. Table 6.2 effectively shows the results of the comparison matrix. The second column shows the Kappa coefficient. Based on these results, all coefficients are above the acceptable level. Moreover, the agreement and disagreement level indicates that almost all questions have around 80 percent agreement from the previous coding and the new coding.

Table 6.2. Validity check results

| Node | Kappa | **Agreement (%)** | **Disagreement (%)** |
|---|---|---|---|
| Auto code | 1 | 100 | 0 |
| Q1- What are the challenges facing logistics integration in Iranian ports | 0.8124 | 86.83 | 13.17 |
| Q2- How can Iranian seaports improve port logistics integration? | 0.7625 | 79.3 | 20.70 |
| Q3- How do you think the sanctions removal will affect the Iranian seap | 0.7850 | 84.9 | 15.10 |
| Q4- Over the next five to ten years, how do you see the role of Iranian p | 0.7992 | 81.96 | 18.04 |
| Q5- Finally, are there any other recommendations for integrating logist | 0.8254 | 83.79 | 16.21 |

## 6.5. Results of qualitative data analysis

In this section, different features of NVivo will be used to analyse the sources. First, the assigned nodes will be examined. Nodes let the researcher collect related material in one place so that he or she can search for emerging patterns and thoughts. NVivo allows flexibility for the researcher to find the nodes which come in different forms of free nodes, tree nodes, case nodes, relationship nodes and matrices (Ishak & Bakar 2012). Free nodes and tree nodes are mostly used by the researcher based on their applicability. In most exploratory studies, researchers prefer to use free nodes to develop themes of their interest because it allows them the free flow of the thematic process. Tree nodes are mostly used in case studies where the researchers have the theoretical framework as a basis for their studies. As mentioned in Chapter 1, the purpose of open-ended questions in this study is to explore and identify the challenges in the Iranian context. Because there is no empirical study in the Iranian context about logistics integration challenges, free nodes method has been used to map the nodes. The flow of data analysis is shown in Figure 6.2. The next section will discuss and illustrate the answers to open-ended questions.

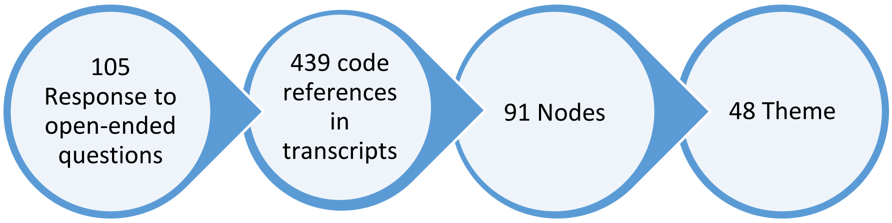



Figure 6.2. Data analysis flow

### 6.5.1. Challenges facing logistics integration

This section illustrates the answers to the first open-ended question ‘ what the challenges are facing logistics integration in Iranian seaports?’. In total, 119 codes have been assigned to answer to Question 1. The results indicate that Iranian seaports are facing a variety of issues which are mostly related to the lack of integration and coordination between logistics chain partners, management /organisational issues, and infrastructural issues which encompass 63 percent of the mentioned issues. Figure 6.3 illustrates all 11 challenges in Iranian seaports.

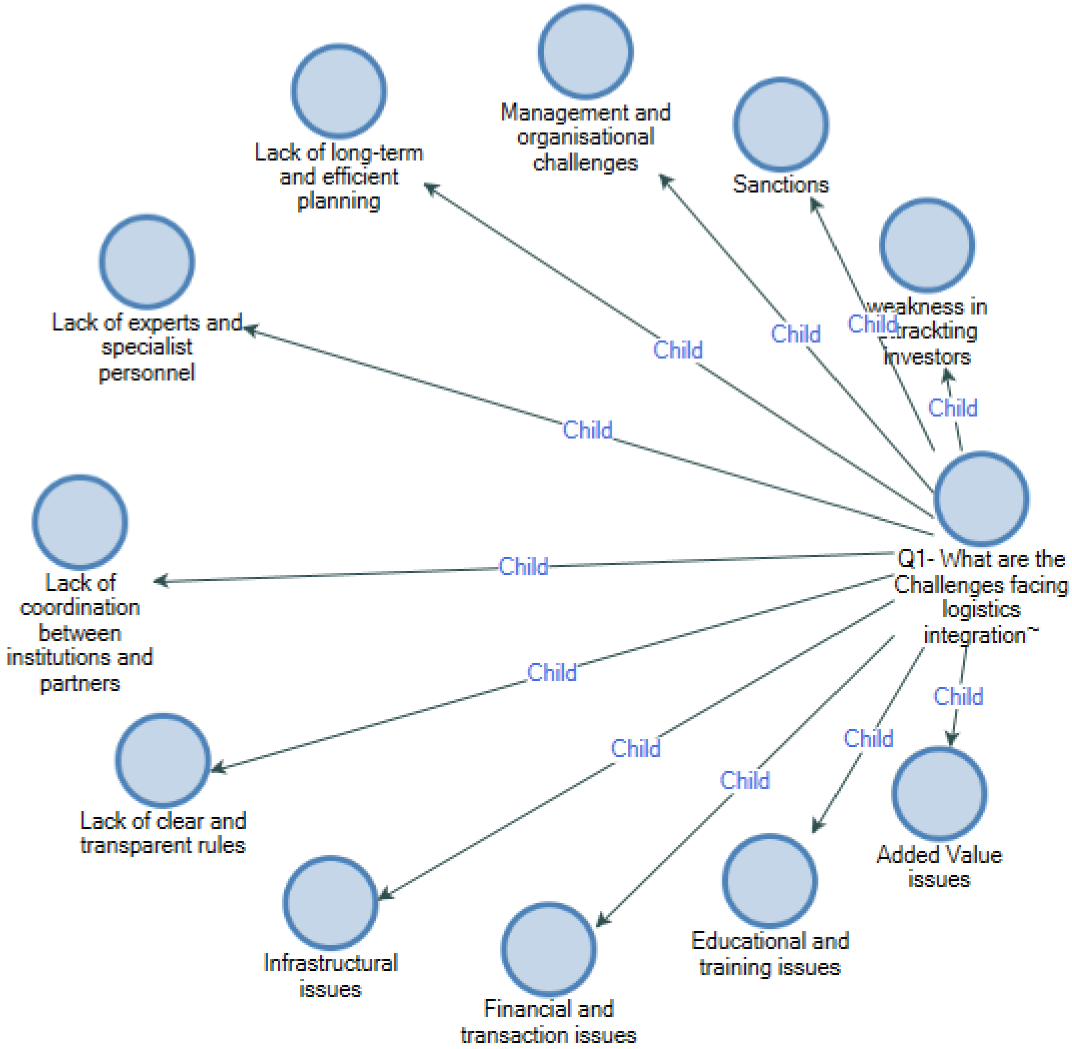



Figure 6.3. Challenges in Iranian seaports

The most important factor regards management and organisational issues, such as a lack of trust between logistics chain partners, strict and unnecessary rules in the customs department, corruption, organisational resistance, administrative and bureaucratic systems, and a lack of strategic vision. It was also found that there is no department or organisation to decide on and implement optimisation processes. This implies that Iran's ports are still managed in the traditional way, and the lack of long-term and comprehensive planning is one of the noticeable challenges. A beneficial consequence of long-term planning is the attracting of investors, specifically private sectors in order to develop logistics practices with logistics chain partners. In addition, some of the problems identified relate to lack of management knowledge and lack of system thinking in top managers. This becomes more obvious when managers must tackle challenges and important strategic decisions for the organisation. Moreover, some participants complained about the port's ownership which creates problems in developing capabilities and improving firm performance. One participant commented:

> *Given that, the ports of Iran are more governmental-owned, the waste of time and energy and even the satisfaction of the clients is not so important for the managers, in fact, government management has made the ports of Iran less developed.*

This is similar to the quantitative result presented in Chapter 5, management and organisational challenges are salient to the Iranian context. Therefore, it can be concluded that the finding in the qualitative and quantitative sections are consistent with each other in terms of management and organisational issues.

The next challenge for Iranian seaports relates to the lack of integrated management and lack of coordination between logistics chain partners. The majority of respondents think that there is neither a transparent nor organised plan to collaborate with logistics chain partners. For example, one of the respondents noted "failure of cooperation with the transportation industry related organisations such as ports, customs, transportation companies and terminals and railway companies". Some respondents suggested that the establishment of a logistics department could help organisations with integrating logistics and transportation activities. Indeed, some respondents believe that traditional and bureaucratic procedures can slow down the integration process. This item is consistent with operational and technological factors in the quantitative analysis which include distribution integration and coordination activities.

Infrastructure challenges are the third important issue raised by respondents. Several items were identified after analysis such as weak transport infrastructure (especially rail) and inefficient logistics infrastructure. In Iran, the railway system does not sufficiently cover important and strategic ports such as Chabahar. Respondents believed that connecting this port railway fleet would have a huge positive impact on logistics infrastructure improvement. Some experts also complained about hardware depreciation such as gantry cranes, inadequate warehouses and limited space for a warehouse. Another infrastructural issue relates to information and communication or information technology, which is "not up to date and consistent with technologies in developed ports such as Shanghai or Singapore port". The last important item under this heading encompasses plans for infrastructural development which is not prioritised in Iranian seaports. This aspect also relates to operations and technology and infrastructure factors in the quantitative analysis section. However, some of these proposed issues have not been identified through the extant literature or our quantitative survey. Therefore, the identified factors show practical needs and challenges in Iranian seaports.

Sanctions are another challenge expressed by respondents. The most challenging issue for import and export companies is money transactions, which make the shipment process very problematic, slow and in some cases impossible. Although most respondents identified that sanctions are the most important challenge in Iranian seaports in the quantitative analysis section, the results of the qualitative analysis results indicate that only a few experts believe that key challenges are related to sanctions. Hence, this factor shows a discrepancy between qualitative and quantitative results.

In addition to the abovementioned challenges, five other challenges have been proposed by respondents which have not been identified in the literature review on logistics integration. Some of the issues are related to the Iranian economy, logistics infrastructure, and specific features such as the impacts of sanctions. Based on the responses, there is a lack of clear and transparent rules and regulations. In some cases, the rules are too strict which the clearance and customs correspondence particularly hard and time-consuming (i.e. 14 days for pharmaceutical and medical products). The other challenge concerns “lack of financial support from the government and financial institutions such as banks and credit institutions in the maritime industry”.

Other challenges to logistics integration have been identified and discussed in the quantitative analysis, such as education and training issues and value-added services. Respondents complained about a lack of knowledgeable human resources with logistics and supply chain knowledge in organisations. In addition, it was advised that a training session should be planned for personnel to develop their knowledge and skills in logistics and supply chain knowledge. In terms of value-added services, one of the respondents mentioned that “lack of sufficient attention [to] the added value of integrated logistics systems, which can create an efficient logistics system”.

Figure 6.4 indicates word count or frequency of the words for the first open-ended question. The figure shows that the most repetitive and noticeable words in responses include management, coordination, infrastructure, integration, planning, rules, institution, financial and training. In sum, based on the discussed results for the first question, it can be concluded that management practices, organisational activities, coordination and integration practices between related logistics partners and infrastructural development are top priorities for improvement.


Figure 6.4. The frequency of words for the first open-ended question

### 6.5.2. Port logistics integration improvement

This section discusses the answers to the second open-ended question, “How can Iranian seaports improve port logistics integration?”. The aim of this question is to analyse ideas of respondents who are engaged with the challenges of port logistics every day, in order to have a practical and realistic view to logistics integration based on the local challenges. Figure 6.5 indicates the primary results and factors mentioned by respondents. These items will be addressed in the remainder of this section.

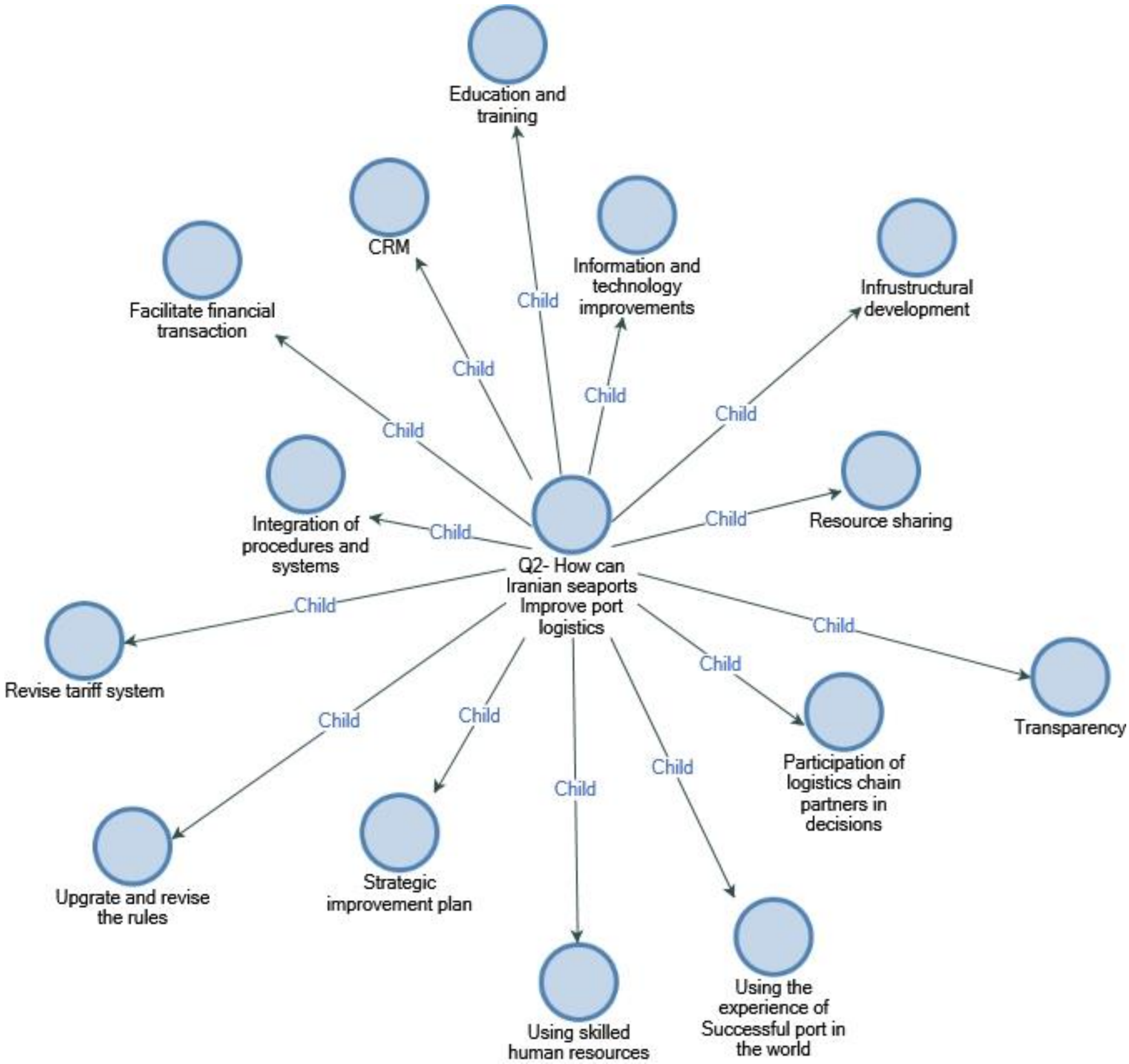



Figure 6.5. Port logistics integration improvement ideas

According to the results, infrastructural development is considered a critical area for improvement in the Iranian port context. Respondents suggested that logistics and supply chain plans should be made in a way that the port plays a 'hub' role for each region in the country; effectively this may enhance port-centric logistics strategies (Mangan *et al.* 2008). Another suggestion in this regard is developing dry ports or multimodal terminals. Dry ports can speed up the cargo movement between seaside and major land transportation networks and create a more central distribution point. Multimodal terminals can also avoid bottlenecks and develop the movement of imports and exports in busy ports such as Rajaee and Imam Khomeini ports. The final points made on this issue relate to equipping and upgrading the ports and their facilities; refurbishing the rail and land transportation; rapid growth in hinterland transport infrastructure; executive devices such as customs, quarantine and shipping terminals; and development of information and communication technologies.

Several participants expressed their view on the importance of involving logistics chain partners in decision making. One respondent indicated the need for “applying the views of all companies associated with port and terminal activities before planning and implementing logistics activities”.  It was suggested that logistics chain partners should establish joint venture contacts as a means to increase cooperation and integration. The following comment was made by a participant:

> *Establishing joint ventures or a memorandum of understanding between related companies for the sharing of profits, risks and rewards of the enterprise. It is also notable that during the joint venture activities, capacity, resources, market share and distribution channels will also share between partners.*

Furthermore, some respondents argued that improvement should be made to the information, technology and communication sectors. Some improvements were suggested for an information network, updating software systems that are tailored to port and terminal activities, and interpersonal sharing and collaboration. Most of the respondents recommend a shared or enterprise database between logistics chain partners such as shipping operators, terminals, transport operators, transport operators, consignees and ports (focal firm) to create a seamlessness information system. One of the port officials suggested that it is crucial to establish electronic system development in container transportation and clearance. He also criticised the electronic system of customs clearance which is too slow and not coordinated with port services.

Another area is human resources since logistics operations are human-centric. Pressures to secure suitable logistics personnel at all levels is obvious ranging from lower levels through to supervisors. Thus, hiring educated, professional and loyal employees will make this process happen. What’s more, people who are planning and implementing logistics practices are making the logistics process more efficient and integrated. According to expert respondents, hiring managers with marine logistics knowledge and train current employees will increase logistics integration.

Another suggestion concerned the integration of procedures and systems by forming a community or working groups to integrate logistics practices among logistics chain partners. A number of participants mentioned that the “port and maritime organisation as the Port Authority, should establish and coordinate with other relevant organisations such as the IRISL Shipping Company, the National Tanker Company, the Railway Agency, the Fisheries Organisation and other organisations [to] be effective in shipping”. In this respect, a couple of experts mentioned that strict rules and regulations, such as the tariff system, are not helping the integration process but rather acting as an impediment. Therefore, it is vital to revise the rules and simplify them in order to facilitate the integration process between partners. One respondent noted:

> *Resource sharing can also help port logistics system to be integrated by sharing the equipment (such as containers, databases and information technology tools), packaging, facilitating handling and transport of received cargos, joint planning, contract services, work and maintenance, human resources among logistics chain partners.*

One of the challenges mentioned in the previous section was not having a strategic plan to improve the logistics system and effectively integrate it. A part of this challenge is clarifying roles in the port network and determining which organisation is responsible for planning. In connection with the point previously mentioned, “a comprehensive short and long-term strategic plan with a guarantee of implementation is needed to achieve a clear and common goal with partners”.

Some respondents believed that one of the best practices in portfolio management and drawing from the experiences of the more successful ports in the world. Portfolio management is a process which includes a number of executive procedures within the organisation, such as periodically reviewing the total portfolio of all activities in one organisation and comparing those activities with the current organisation; and developing a new strategy for the firm, complete with strategic resource allocation decisions. This process will help to identify organisational areas that need improvement and to make effective decisions that address them. Some respondents suggested that the ports of Shanghai, Singapore, Hong Kong and Busan as an exemplar to study in portfolio management.

Finally, a few participants mentioned customer relationship management (CRM) strategies. Such considerations could attract more investors and customers to the port and facilitate financial transactions and transparent relationships with logistics chain partners which are indirectly related to logistics integration.

Figure 6.6 indicates frequently repeating words in the responses for the second open-ended question. As it can be seen, joint venture, infrastructure development, management, planning equipment, software human resources, resource sharing, investment and training are popular words among participants.


Figure 6.6. Frequently repetitive words

#### 6.5.2.1. Different actors' perspective on logistics integration

Further analysis of the responses to the second open-ended question indicates that different actors have different priorities for improving logistics integration. According to the responses from port authorities, which comprise the main group of respondents, it can be inferred that infrastructural development (specifically in information systems and smart technologies), organisational relationships and developing relationships with different institutions (such as government and educational institutions) are highly supported. On the other hand, participants from shipping line companies asserted that infrastructural developments activities such as transport operation facilities, looking to the example of successful ports and resource sharing are the top priorities for improving logistics integration. Terminal operators believe that using skilled human resources, privatising the private sector and establishing joint venture contracts should be prioritised. Stevedoring companies have the near exact opinion as terminal operators but go further to highlight the importance of integrating seaport procedures and systems. The leading suggestion for improvement in the warehousing sector was investment in dry ports as well as improving information sharing technologies. Freight forwarding, import and export companies believe that the customs and tariff systems need to be revised. They asserted that tough rules in cargo clearance are the main cause for the lack of efficiency in Iran’s port logistics system. Finally, many land transport companies suggested the need for infrastructural developments.

### 6.5.3. Impact of sanction removal

This study sought participants’ view on the impact of removing the sanctions against Iran, which unfortunately were reverted recently. As mentioned in section 3.2.2 in chapter 3, after signing JCPOA that gave the country's maritime transportation industry an opportunity to recover the industry, Iranian seaports signed contracts with different shipping companies in the world such as Maersk company. Thus, this question is designed to discover the improvement sources to develop port logistics integration.

The results of the analysis indicate that sanction removal will result in increased investment, infrastructural development, a partnership with foreign companies, facilitate financial transactions, information and technology development, improvement in logistics fleet and create new markets. However, the US withdrew the JCPOA deal and reimposed economic sanctions against Iran that were lifted in 2015. Reimposing sanctions will limit the opportunities and development plans on the Iranian economy as well as port logistics. Thus, the result of the analysis for this section needs to be further discussed in Chapter 7, given the renewal of the sanctions.

### 6.5.4. Iranian ports’ future in comparison with neighbouring countries

This section discusses the answers to the fourth open-ended question, “Over the next five to ten years, how do you see the role of Iranian ports in comparison with neighbouring countries’ ports? The aim of this question is to find out the experts’ ideas on the future of the Iranian logistics system; how the market share of Iranian seaports could be increased by overtaking rivals and learning from neighbouring ports' strategies. The results show that there are three main streams in participants responses. The first group believed that Iranian ports will be more active in the near future. On the other hand, some participants had their view of the complete opposite, believing that progress will not be made or that the situation will worsen. Other participants predicted that the logistics system will remain in the current situation or will have a medium rate of growth.

Those respondents who think that the Iranian logistics system will improve mostly focused on three items: sanction removal, economic growth and infrastructural development. In terms of sanctions, one of the participants stated that 'with the lifting of sanctions and increased trade, there will surely be a good future filled with financial transactions that will bring the most profits to manpower'. Other participants believed that although the rate of economic growth (in total) and the growth of transport are very slow. It is expected that this growth will accelerate in the coming years due to the expected economic developments. The third group believed that infrastructural developments are bound to occur during the next 10 years. For example, one expert remarked:

> *The marine industry, like the rest of the industry in Iran, requires a long time to grow and flourish. However, I believe that over the next 10 years, we will be able to compensate for the shortcomings and backwardness of the past few decades, and there is an acceptable prospect. For example, the development of moorage docks Container ships with a capacity of over 14,000 TEU in Bandar Rajaee with the assistance of Iran's Shipping Company through the purchase of several Mega Container Ferries at present, as well as the development of the domestic shipbuilding industry by sending domestic specialists to Korean shipbuilding companies and Also, the creation of new logistics companies to optimize and utilize future capacities.*

As mentioned above, the second group was pessimistic about the development and growth of the logistics system. This group of participants believed that, considering the internal factors and existing barriers, there will be no significant improvement in the next 5 to 10 years. According to the results, a lack of attractiveness, lack of transparency, sanctions, management and leadership issues, and infrastructure issues were the most debilitating factors. In this regard, one participant noted:

> *Without clear planning by senior officials in order to develop ports of the country, without transparency of decision-making processes in various fields, such as the determination of port operators, it is clear that the ports of Iran don't have opportunities to compete with the port hub area (Jebel Ali United Arab Emirates), they will be complete losers in competition with the Sahar (Oman) and Gwadar (Pakistan) ports.*

The third group believed that if the suggested reforms (e.g. infrastructural development, integration and procedures and systems) and deregulation to the sector are carried out, the industry will be able to rival with that in the neighbouring countries.

### 6.5.5. Recommendations and suggestions

The last open-ended question of the survey allowed participants to express their view "any other recommendations for integrating logistics systems and overcoming the challenges in Iranian seaports?". The majority of the recommendations provided by the participants are related to infrastructural and information and technology development. For example, one of the participants stated:

> *I recommend that the first step is to integrate logistics through transportation hubs, including dry ports, distribution centres and logistics parks, which requires positioning based on existing potential and attracting investors to realize this. Moreover, equipping ports with modern technology, developing ICT, using information systems and creating required staff and accessing railway are other priorities to increase logistics integration level.*

Another important suggestion pertained to revising the customs and tariff system. Some believed that customs cause a bottleneck in Iran's port logistics. Improvement to the tariff system of ports, changing the customs system and simplifying the mechanism of the discharge and transit would have a crucial impact on the integration of logistics in seaports. Participants suggested that the single electronic window for carrying out all port and customs formalities and unity of the customs are two possible ways to overcome this challenge.

Along with logistics integration activities, using the Logistics Performance Index (LPI) can also help seaports to identify their level and implement strategies based on their shortfalls to increase logistics integration and performance level. The LPI is an interactive benchmarking tool proposed by the World Bank to help countries detect the challenges and opportunities in terms of performance on trade logistics and provide suggestions to improve in these areas. According to the World Bank report for 2016, Iran ranked 96th in terms of six LPI factors among 167 countries. These six factors include customs, infrastructure, international shipments, logistics competence, tracking and tracing, and timeliness. Based on this index, customs, tracking and tracing and timeliness were identified as the most challenging factors.

In addition to the items mentioned above, the suggestions provided concern with the needs for revising the relevant rules, comprehensive planning, effective management, facilitating foreign investment, establishing a coordination organisation for integration purposes, hiring skilful employers, facilitating banking transactions, portfolio management, outsourcing the logistics activities to the private sector, and educational courses and seminars. Figure 6.7 presents a summary of the issues in the responses to the fifth question.

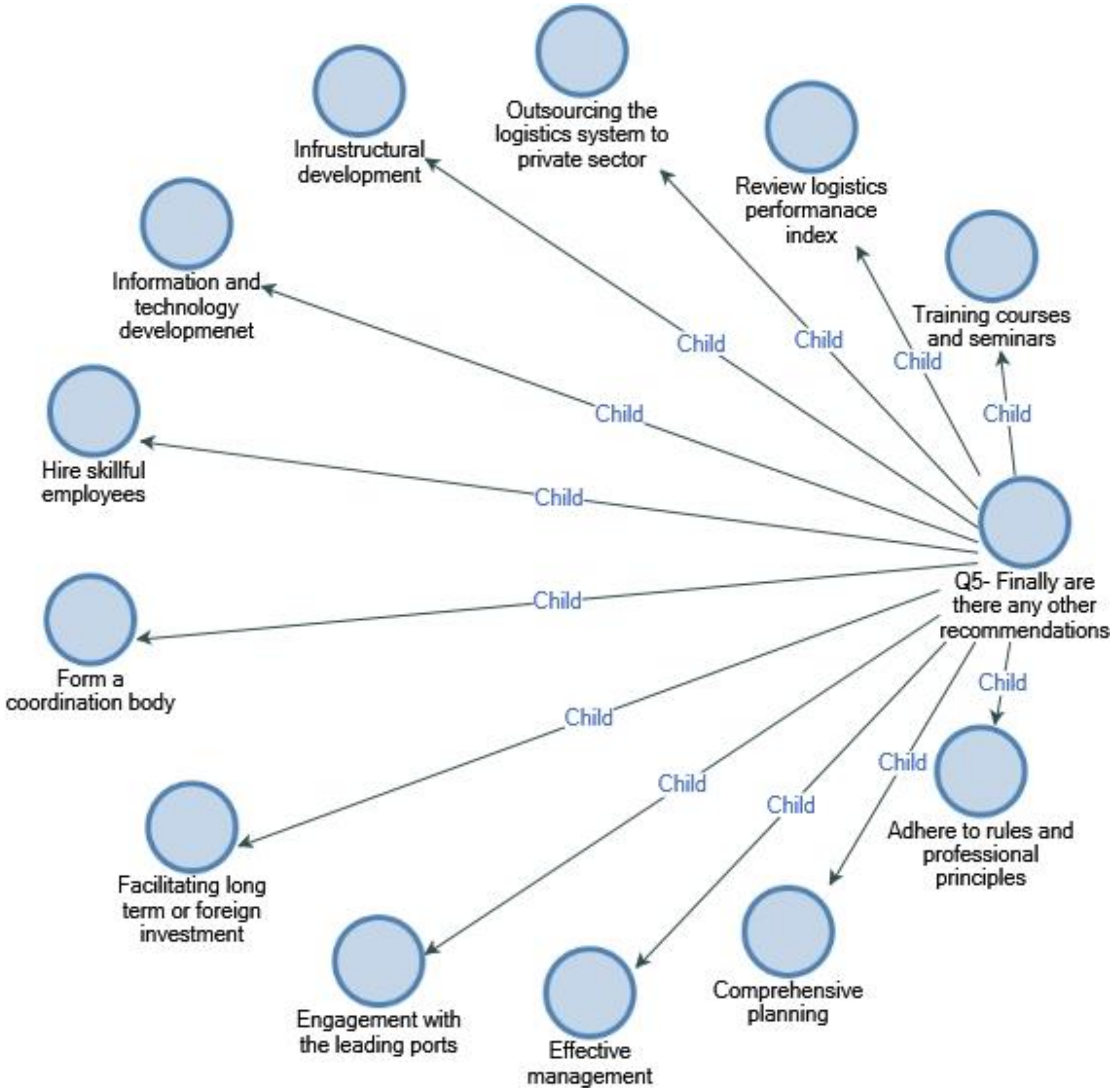



Figure 6.7. Suggestions and recommendations for logistics integration

## 6.6. SUMMARY

This chapter presents the qualitative analysis results to answer the third secondary research question concerning the challenges in logistics integration. The data were collected from the answers from 105 participants to open-ended questions on challenges in the Iranian port's logistics integration.

The results of the qualitative analysis using Nvivo software indicate that the lack of integration and coordination between logistics chain partners, organisational management and insufficient infrastructure were the most important challenges in port logistics integration in Iran. Other challenges to port logistics integration such as coordination between logistics chain partners have also been identified as suggested by the literature.

The analysis for the second open-ended survey question has found various measures and strategies to improve logistics integration in Iran, including infrastructural development, participation of logistics chain partners in the decision-making process, information and technology development and integration of procedures and systems were highly recommend by experts and managers in order to overcome the challenges and improve the logistics chain level. Revising and simplifying Iran's customs and tariff system should be a top priority in improving the logistics chain.

The answers of the participants to the third question regarding the effect of sanction removal indicated positive views on the sanction removal, which was well regarded as a key contributor to improve demand for port services and port performance. Unfortunately, this effect no longer exists due to the renewal of the US sanction on Iran.

Respondents have different views when asked about the future of the port sector (the fourth question). While some had a positive view on the development of the maritime sector including ports and improvement in the maritime business environment, others are less optimistic. The majority of participants believed it is essential for the sector to have a long-vision for future development.

# CHAPTER 7: DISCUSSION OF THE RESULTS AND IMPLICATIONS

## 7.1. Introduction

As presented in Chapter 1, the objective of this study is to investigate port logistics integration in the Iranian port sector. It seeks to answer the following primary research questions (PRQ):

> **"PRQ: How can logistics integration in Iranian seaports be improved?"**

This primary research question was divided into three secondary research questions (SRQs). The first secondary research question (SRQ1) is:

> **"SRQ1: What are the key factors in port logistics integration?"**

To answer SRQ1, a literature review was conducted in Chapter 2 and identified the following seven key factors in port logistics integration:

- Resource sharing
- Organisational activities
- Institutional support
- Information and communication integration
- Value-added services
- Processes and operations
- Logistics practices

Based on the answer to SRQ1 in Chapter 2 and the background of the Iranian port sector presented in Chapter 3, the research methodology was developed in Chapter 4. Subsequently, Chapter 5 presented the answer to the second secondary research question (SRQ2):

> **"SRQ2: What are the critical factors in logistics integration from the Iranian ports' perspective?"**

The answer to SRQ2 was made based on the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) of data collected from Likert scale survey questions.

Chapter 6 provided the answer to the third secondary research question (SRQ3):

> **"SRQ3: What are the challenges facing Iranian port logistics integration?"**

This was done through an analysis of data collected from the open-ended question survey of senior staff and managers from Iranian ports.

The objective of this chapter is to discuss the analysis results (presented in Chapters 5 and 6) and present the implications for port management. The rest of this chapter is organised as follows. Section 7.2 discusses the findings on the critical factors in Iranian ports' logistics integration. Section 7.3 discusses the challenges facing the Iranian port sector and its logistics integration. Section 7.4 is the chapter summary and conclusion.

## 7.2. CRITICAL FACTORS IN LOGISTICS INTEGRATION OF IRANIAN PORTS

This section discusses the results of factor analysis in Chapter 5 concerning the seven key factors in port logistics integration mentioned above. The next seven sections, from Section 7.2.1 to Section 7.2.7 discuss the results of factor analysis concerning the seven factors in Iranian port's logistics integration respectively.

### 7.2.1. Resource sharing

As logistics is a continuous process and involves interactions between various logistics partners for the physical movement of goods, sharing the resources and activities will improve the integration and coordination in the whole chain. It has been found that the first factor in port logistics integration, resource sharing, is comprised of the following four key areas in logistics operations:

- Joint development of packaging
- Optimal procurement process
- Optimal subcontracting
- Involving actors in decision making

Finding on resource sharing factor in chapter 5 is in line with the findings of earlier research (Bagchi *et al.* 2005; Cagliano *et al.* 2006; Quesada, Rachamadugu, Gonzalez & Martinez 2008; Alfalla-Luque, Medina-Lopez & Dey 2013). It involves actors giving access to each other's resources (both physical and human resources) for mutual benefits (Huo *et al.* 2015).

The study found four potential areas for Iranian ports to share resources with their logistics partners. In terms of the joint development of packaging and searching for optimal subcontracting, Quesada, Rachamadugu, Gonzalez and Martinez (2008), Alfalla-Luque, Medina-Lopez and Dey (2013) and Frohlich (2002) provided strategies and mechanisms to induce a higher level of integration among actors of the logistics chain. Such practices include packaging customisation, sharing production, common use of logistical equipment/containers, search for an optimal subcontracting for the entire SC plans and involving the SC members in decision making. The packaging, consolidation and deconsolidation are considered crucial factors in 3PL (third party logistics), 4PL and 5PL (Aguezzoul 2014). Sharing resources in packaging activities would allow for ports and their logistics partner to optimise the use of their resources. These include, for example, the shared use of port infrastructure and warehousing facilities, shipping containers, shippers' special knowledge, skills and equipment for packaging, consolidation and deconsolidation.

Ports can also develop good relationships with logistics chain partners and hold meetings with them to improve the procurement processes. Procurement is another important factor in logistics management and resource sharing; concerned with finding, agreeing on terms and acquiring goods, services or works from an external source. This process ensures that customers receive products and services in the best possible quality and at a reasonable price (Van 2010). Seaports facilitate the procurement of raw materials through value creation attributes such as reliability, punctuality, frequency, availability of information, and security (Carbone & Martino 2003). Another way to improve the procurement process is by establishing a contract management system. This would effectively handle contracts with logistics chain actors to make the resource sharing process easier and faster. In terms of searching for optimal subcontractors, in some cases, optimal solutions will be made to share resources using logistics service providers or third-party logistics companies. Furthermore, subcontracting the supply chain relationships can be extended beyond the simple exchange of cargos or services, to integrate the design, distribution and knowledge sharing between the actors (Dainty *et al.* 2001). Joint decision making is considered another vital important activity among supply chain members; in particular, in cases of demand forecasting and supply management. Decisions based on each firm's data and statistics may result in the wasting of resources and decreasing the efficiency of the logistics chain. Joint decision making, specifically in terms of sharing the resources among actors, contributes to controlling the dramatic swings in demand that occur in functionally oriented logistics chains (Barratt 2004), thereby increasing synergy. In order to build excellent relationships with logistics chain partners, Pearson (2015) provided important suggestions. The first suggestion is about having face-to-face meetings in their own offices on a regular basis to build strong personal relationships and let partners learn from each other in terms of managing businesses and facilities. The second suggestion concerns taking time to understand the partners' values, aspirations, commitments, values and ethics as well as making sure that the companies are consistent in those presumptions. The third recommendation is to keep in regular contact regarding each actor's workload, new contract, new cargo and new contracts or any failures to make them ready for future actions and collaborations. And finally, Pearson (2015) suggests sharing any complaints (joint problem solving) from customers to each logistics partner and investigate the reason for complaints. The success of good relationships and collaborations between partners cannot be assured unless performance is properly measured and monitored using key performance indexes, quarterly executive business reviews and continual updating of key metrics and goals (Min *et al.* 2005).

### 7.2.2. Institutional support

As mentioned earlier in Chapter 2, logistics activities and functions that are directly and indirectly achieved through the relevant institutions (such as governmental, financial and educational institutes) offer support to logistics chain members. As the Iranian port logistics system is ruled by the government, the related financial and governmental institutions have a huge impact on logistics integration in Iran. Supporting this view, the analysis results indicated the significant role of institutional support in logistics integration. Different from the last factor relating to resource sharing, this factor concerns the institutional aspect of logistics integration. The study found four dimensions in institutional support, namely:

- Approving business loans/microcredit facilities with lower interest rates
- Facilitating leases e.g. vehicle, warehouse, IT, shipping equipment
- Financial support for logistics providers to build new facilities
- Research for identifying and implementing the best practices in freight transport

These dimensions are corroborated by previous studies (Sumantri & Lau 2011; Kauppi 2013; Codron *et al.* 2014). Institutional support to the Iranian port sector can be supported by financial organisations and particularly the government, given their essential role in the financial sector and managing the state budget for the national economy. Financial flow is considered as three main flows in supply chain integration: information, material (physical), and financial (Rai *et al.* 2006). It is important to monitor and control financial resources between a focal firm and logistics chain partners. As mentioned in Chapter 3, the Iranian port system is mostly owned by the public sector (especially the government). Therefore, providing financial facilities (business loans/microcredit with lower interest rates) will significantly improve the logistics infrastructure in the port sector. In terms of facilitating leases and financial support, investing and increasing credits for ports will improve port logistics integration.

More interestingly, the respondents in the qualitative section highlighted the role of the government's support in different ways. As mentioned earlier, ownership and management of Iranian seaports are strongly linked to governments policies and strategic plans. For example, upgrading and revising the rules, as well as revising the tariff system and strategic improvement plans, are highly dependent on the government's policy. Thus, government support is considered an Irrefutable part of overcoming logistics integration challenges and improving the port logistics system. On the other hand, developing infrastructure and facilitating financial transactions are dependent on how interested financial institutions and banks are in investing in the port logistics system. Attracting their attention to invest in port logistics will have a huge impact on infrastructural development which leads to logistics integration.

While educational support was rejected in factor analysis, it has been considered by other studies as a crucial element of logistics integration (Sumantri & Lau 2011; Habib 2014). What's more, it was mentioned by a few respondents in the qualitative section.

### 7.2.3. Organisational activities

The integration process cannot succeed without dynamic bonds between logistics chain partners. This may involve encouraging teamwork, building trust and fostering long-term relationships. Such relationships can be categorised intra-organisation activities (inside each firm) and inter-organisational (between various firms) in the logistics chain. The study has found that port logistics integration can be supported by organisational activities especially in the following areas:

- Encouraging teamwork within internal cross-functional teams so that they can work in diverse situations
- Encouraging teamwork where new employees are added into an existing and highly experienced team

- Building interpersonal trust to create/maintain long-term relationships with other distribution partners by keeping the interests of all stakeholders in mind
- Guiding organisations towards a joint search for end-customer satisfaction

Teamwork is a crucial contributor to the success of alliances and relationships between logistics chain partners (Stock 2006). It was also found that logistics chain partners are motivated to make organisational relationships since they are inclined to make interpersonal, inter-organisational and emotional investments in cooperations (Day 2000). As indicated by respondents, teamwork can be promoted within the organisation. For example, when organisations are recruiting a new employee to the system, teamwork will increase the adaptability and efficiency of the new employee and reduce the learning curve. It can also be external to the organisation, i.e. between port logistics chain partners (Pinmanee 2016).

The study also found that building interpersonal trust to maintain a long-term relationship with partners is conducive to logistics integration. Trust building effectively improves communication, making the correspondence and interactions quick and precise. This promotes ports' relationships with stakeholders including consignees, terminals, shipping companies, truck and rail companies and other related partners.

Similarly, improving customer satisfaction is an important aspect of any supply and logistics chain. It reflects ports' operational performance in areas such as the cargo handling process and value-adding services (Kim 2009). Thus, ports and their actors need to work together to improve the level of service quality.

The above findings are in line with Wang and Wu (2010), Alfalla-Luque, Medina-Lopez and Dey (2013) and Green Jr *et al.* (2008). In particular, promoting teamwork and external collaboration between logistics and cross-functional teams is found to be as important as other organisational activities such as trust and commitment (Alfalla-Luque, Medina-Lopez & Dey 2013), sharing risks, costs and rewards (Swink *et al.* 2007).

#### 7.2.4. Value-adding services

Value-added services entail the ability of ports to add value to the delivery of cargos, offering competitive functional services at a minimum cost (Song & Panayides 2008). Thus, these activities will enhance the competitive advantage of the port by improving the quality of the products in the logistics chain. According to the study results, value-adding services are among the most important factors in logistics integration for Iranian seaports. Furthermore, the analysis has found the following areas are critical to value-added services:

- Logistics storage equipment e.g. pre-assembly, manufacturing, packaging
- Ability to respond quickly to changes in market demand
- Involving the partners in the development process
- Adequate facilities for adding value to cargoes

Regarding value-adding storage equipment, respondents supported that the notion that different equipment for warehousing and storing the cargos will increase the value of the logistics chain. Material Integration Centres (MIS) is an alternative method for storing cargo, capable of handling a wide range of products while adding value to the cargos. This method was introduced by Banneker industries to increase space availability, maintain product integrity, and enhance product visibility, safety and security (Banneker 2018).

In terms of quickly implementing customer changes, as shown in Paixão and Bernard Marlow (2003), it is crucial for the next generation of ports to have the capability to meet customers' demands in a  continually evolving environment. Part or the whole of the production process could be better managed within the port's logistics system, enabling port marketing department to quickly adapt to changes in market conditions when needed.

Ports can improve their logistics integration by involving logistics chain actors from different sectors. These activities may have a direct positive impact on the final product or cargo. For example, collaborative activities in packaging, design, procurement and assembling could help to improve the value of the product (Clayton 2018).

In providing value-adding services, ports may also require investments in better facilities. For example, up-to-date inventory management tools, cross-docking and warehouses can help to achieve this objective. Ports can contribute to the value-adding process by offering different operations and services through their facilities and infrastructure, including new tailored services and handling different types of cargos to diversified routes/ modes (Carbone & Martino 2003; Song & Panayides 2008; Tongzon *et al.* 2009).

It is interesting to note that although some respondents mentioned the importance of value-added services, they didn't consider this factor as a priority in port logistics integration. The respondents did, however, offer examples of beneficial value-adding service activities including customer relationship management (CRM) and infrastructural development.

### 7.2.5. Process and operations

Process and operations refer to the set of operations to facilitate cargo distribution and cargo handling along the logistic chain. It also investigates the physical flow of cargos, modal shifts and the links between partners along the logistics chain. As mentioned in 2.6.4.2.3, this constitutes one of the three main flows in the logistic chain. The 'process and operations' factor covers three key areas:

- Level of a modal shift among different modes of transportation
- Joint transport planning and control processes
- Developing partnership for better service quality

As ports are nodes in the transport and logistics system, connectivity to different modes of transport is critical to their functionality and hence logistics integration. Respondents suggested that integration among different types of transport modes in essential for logistics integration. According to Rodrigue *et al.* (2016), modal shift or connectivity allows for more flexibility and better management of transport costs and service availability. Ports that have links to both rail and road transport, such as Shahid Rajaee, Imam Khomeini and Bandar Anzali ports, would have more of an advantage in logistics integration.

Joint transport planning and control processes are the second area of the process and operations factor. This can be defined as cooperation between different logistics chain partners at the same level (horizontal) or across a logistics chain (vertical) in transport and logistics. It helps ports to achieve economies of scale and to improve customer service quality, avoid unhealthy competition, and prevent congestion or bottlenecks (Cruijssen *et al.* 2007).

Partnerships also need to be developed among ports, enhancing each port's service quality and reducing distribution costs. Respondents indicated that managing service quality through partnership is important to port management. Specifically, focusing on the quality of services in different parts of the logistics chain will keep partners on the same level to create an integrated logistics chain. Moreover, partnership and collaboration help to build resilience in the logistics chain to manage unexpected contingencies (Wei *et al.* 2012).

These items are consistent with the findings of the Panayides and Song (2009), Bichou and Gray (2004), Meixell and Norbis (2008) and Song and Panayides (2008). The process and operation concept is in close relationship with the supply chain management concept, covering supply chain coordination and resource sharing which has been discussed in a separate section.

It is advisable that Iranian ports develop quality standards used for the whole logistics chain to ensure logistics chain partners are using the same level of quality in their processes and operations. As suggested by respondents, increasing transparency among logistics chain partners, managing service quality, following quality standards, and forming unions, communities or teams to agree on standards will improve port logistics integration.

### 7.2.6. Logistics integration practices

Logistics integration practices refer to searching for different process and activities beyond routine logistics chain activities to increase performance. The sixth factor refers to the role of logistics operational practices in logistics integration. These include:

- Identifying transport modes for linking seaports to the hinterland
- Identifying least-cost options for transport
- Evaluating alternative routes for increasing transport efficiency

Logistics practices cover ports' operational procedures, activities and processes. For the purposes of logistics integration, these necessarily go beyond a port's boundaries and daily activities, allowing the port to collaborate with its partners and identify cost-effective logistics solutions (Tongzon *et al.* 2009). The first element, identifying transport modes for the hinterland (including dry ports and final destinations), would allow Iranian seaports to improve connectivity with the hinterland and decrease congestion. Similarly, identifying least-cost options for transport to and from the hinterland and final destinations is the significant financial benefit of logistics integration practices. According to Litman (2007), many factors should be considered in the economic analysis of a transport system to manage and control costs such as travel time, service reliability, congestion and total transport cost. This is also related to the third underlying area, evaluating alternative routes for increasing transport efficiency. As indicated by the survey respondents, searching and investigating different routes is essential for a logistics chain. For instance, an analytical method such as vehicle routing problem (VRP) could be used to aid the planning and evaluation of alternative routes (Caric & Gold 2008).

#### 7.2.7. Information integration

Researchers tend to agree that information integration is the most critical factor in logistics integration (Uusipaavalniemi & Juga 2008; Bae 2012; Alfalla-Luque, Medina-Lopez & Dey 2013; Mellat-Parast & Spillan 2014b). It refers to sharing key information along the supply/ logistics chain partners to increase integration and coordination (Prajogo & Olhager 2012). As discussed in Chapter 2, logistics processes cannot be handled without using information systems between logistics partners. The study found information and communication integration is significantly related to the following two areas:

- Online transaction
- Application of electronic data interchange (EDI) and online booking system

Online transactions and web-based communication are highly regarded elements in transport and logistics (Song & Panayides 2008; Klein & Rai 2009; Lam & Zhang 2014). The survey results found that using IT and web services is essential for integration activities in the port logistics chain. The survey also found that ports were aware of their operational need for the use of information and communication technologies (ICT) such as e-documentation and cargo tracking.

In terms of adopting electronic data interchange (EDI), respondents highlighted its potential to improve transport operation efficiency with logistics chain partners in information and communication integration. Using EDI technology could result in cutting the response times, improving management technology, improving processes to reduce costs and automating the generation, sending, receipt and recording of exchanged documents (Edicomgroup 2018). Based on the research results, EDI technology will continue to be a major technological standard and major tool for sharing information to conduct B2B transactions in Iranian seaports. As EDI is a constantly evolving technology, it is suggested that EDI technology can be implemented and updated by port logistics chain partners. On the other hand, the roles of governmental, financial and educational institutions are also important in ensuring EDI adoption. Thus, these institutions should help implement these efficient technologies in terms of funding, investing and holding training and seminars to upskill employees (Rawashdeh & Al-namlah 2017).

Previous studies have highlighted the pivotal role of information sharing (Uusipaavalniemi & Juga 2008; Lin *et al.* 2009) in information integration within logistics integration. The results of the qualitative analysis also indicate that information and communication integration is one of the three important priorities for logistics improvement. Data sharing between logistics chain partners can improve processes and liaise among shipping operators, terminals, transport operators, consignees. In effect, port operations would greatly benefit from a seamlessness information system.

### 7.3. Challenges facing Iranian ports' logistics integration

The survey and interviews of senior staff and managers of Iranian ports revealed several challenges facing the sector. First, port infrastructure is insufficient, particularly within port logistics and transportation systems. This affects the sector's ability to play a central role in multimodal transport and logistics operations. One of the main reasons for this deficiency is the lack of funding from the Iranian government. As the owner of a large portion of Iranian seaports and related industries, the government has direct responsibility for the budget for infrastructural development. The economic downturns in recent years have accordingly limited the ability of the government to allocate sufficient resources for port development. This has been compounded by the need for the involvement of different organisations and institutions in infrastructure development in Iran.

Despite the government's desire to attract capital from private and foreign companies, investment from these sectors in Iranian ports is very limited due to public administrative, institutional and regulatory barriers. Located in the Middle East, an insecure region for investment for several years, Iran rarely attract investments from foreign companies (Dehghan *et al.* 2018). Another economic challenge relates to the international sanctions imposed on Iran. Other obstacles include excessive expansion of the public sector, currency renewal, inefficient trade policy, economic instability, insufficient public infrastructure, lack of incentives and measures to promote the sector, as well as insufficient manpower (Rahimi Broujerdi 1996).

The lack of appropriate infrastructure in Iranian seaports is mostly related to transport facilities, namely those of rail and trucks. According to a large number of experts, rail transportation and infrastructure is a major challenge in infrastructural development. Due to network and infrastructure degradation, the rail network in the southern ports cannot play a significant role in cargo transportation. For example, Shahid Rajaee port, which is the high-traffic and largest seaport in Iran, still doesn't have developed rail transportation. Hence, more than 95 percent of the goods in this port are shipped by truck. Another example is Chabahr port which, despite its excellent geopolitical location and strategic placement to convey cargos from central Asia to Europe, is yet to be connected to the railway network. What's more, most of the terminals in large ports are poorly designed and utilise outdated technologies.

Regarding high terminal charges, respondents believed that terminal charges is one of the challenges in Iranian seaports and it will decrease their competitive advantage among neighbouring countries. Port service pricing, like all pricing, depends on the supply and demand power. But perhaps in the shipping industry, factors that have an impact on demand are more complex than other industries and services. A good pricing system should take into account the costs and related constraints facing the service provider but also market competition and benefits to users.

Thus, as noted by Arabzade Hossini and Shahbazi (2013), the port can overcome these challenges in different ways; for example, port charges and tariffs calculated based on engine power and operating hours, flexible pricing (e.g. discount for frequent customers), port marketing and promotional campaigns.

The result of qualitative analysis has found that Iranian customs are another challenge facing Iran's import and export documentation. In particular, some respondents expressed their concerns about customs working just one shift a day. If customs working hours were extended and the customs procedure became streamlined, this would improve the efficiency of export and import documentation. The use of technologies in cargo inspection and paperwork is also vital. For example, more extensive use of X-ray devices for container inspection can help quicken customs processes. The increase in the number of these devices and their expansion in all parts of the country's borders would be a huge step forward.

Furthermore, it was found that the lack of support in coordinating logistics activities and working logistics chain partners is another hurdle in logistics integration. The non-standard and limited rail system slows down the speed and efficiency of cargo handling and transportation. Thus, it is important for the rail sector to be developed and aligned with seaport development and road transport. Policy makers need to consider new measures to expand the country’s transport and logistics infrastructure system including seaports. Moreover, relevant reform measures such as deregulation, commercialisation, corporatisation and privatisation (Bank 2007; Brooks *et al.* 2017) are essential to promote the competitiveness of port, transport and logistics service providers and allow prices to be set according to the market conditions and reasonable to keep the business of customers (Yeganeh 2016).

The qualitative analysis results also indicate that poor customer relationship management and a shortage of skilled human resources are other notable challenges in ports management. In particular, respondents believe that there were not enough incentives and activities to attract port customers. It was suggested that the marketing department needs to be established in ports to attract customers to use the services. Marketing activities such as market research play a key role in identifying customer’s needs especially for new services and the areas that require improvement. In order to meet customers needs, different strategies such as value-added services can be established to overcome this challenge. In terms of a skills shortage, respondents believed that the shortage of logistics and supply chain knowledge is a key challenge in this area. They also suggested that staff training and recruitment could help organisations to overcome knowledge and skills shortages. To stay competitive in the market and promote logistics integration, these ports and companies require strong leadership, management and effective communication. Accordingly, skilled and experienced employees in these areas are critical for the effective development of logistics chain networks (Jurčević *et al.* 2009).

The last challenge in port logistics integration is related to various economic and political sanctions against the country. At the time of completing the data collection for this study, the economic and political sanctions were reimposed on Iran. According to the Joint Comprehensive Plan of Action signed by China, France, Russia, United Kingdom, the U.S. and Germany in 2015, parts of the economic and political sanctions on Iran were going to be lifted. However, the U.S. has withdrawn from the agreement to renew its sanctions on Iran in May 2018. Thus, it is essential that the sector finds other profitable avenues despite its inhibited trade and connectivity with the outside world. For example, it is vital that the sector focus more on domestic instead of international trade. On the other hand, there is also a need to strengthen trade relationships with traditional partners.

## 7.4. SUMMARY

This chapter discussed the key findings relating to the central factors and challenges in Iranian ports' logistics integration that were presented in Chapters 5 and 6. In light of the research findings, this chapter also discussed the implications and provided recommendations for Iranian ports.

Several issues and implications have been drawn from the findings relating the seven influential factors in port logistics integration, namely resource sharing, organisational activities, institutional support, information and communication interaction, value-added services, process and operations, and logistics practices. First, it was found that while infrastructure plays a critical role in port operations, Iranian ports' infrastructure is insufficient to facilitate efficient cargo handling and logistics operations. This is mainly due to the government's limited financial support and administration.

Second, despite the government's efforts to attract private investment in the sector, it is far from enough, given the sector's gaping need for port infrastructure and cargo handling facilities. Thus, investment funded by private and international companies is important to overcome this challenge. The participation of the private sector needs to be encouraged and governance reform is necessary for the sector as demonstrated by experience in port reforms across countries in the world (Brooks *et al*. 2017).

Third, the sector also faces knowledge and skills shortages that affect ports' abilities to integrate and collaborate with partners and stakeholders. Therefore, training and human resource management can help to fill this gap. Another area that requires investment is information and communication integration. ICT application and investment are essential to support port collaborations with other logistics partners and customers.

Fourth, port logistics integration requires the ports’ connectivity and access to various transport modes. The nonstandard rail system with limited capacity (such as the degradation of the rail network and infrastructure around the southern ports) is a significant obstacle to port logistics integration. Therefore, extensive investment in the public transport infrastructure is needed to allow for the efficient operation of the transport and logistics system.

Fifth, given the government’s control of ports, the existing lack of market competition will likely result in insufficient port charges and inferior service quality. It is necessary to promote competition in the sector and allow charges to be based on market mechanisms and be reasonably set to keep the business of port users. Port marketing and service quality management are essential in the ports’ responding more effectively to port users’ needs. Thus, port reform should provide an incentive for port management to improve port performance.

Seventh, the political instability of the region is also a noteworthy challenge, affecting the ports’ abilities to attract private and foreign investment. A much broader-based reform would be needed for the country to create a viable business environment for economic agents and market work.

Finally, the economy as a whole and the port sector undoubtedly have been constrained by various political and economic sanctions imposed against the country and its people. Thus, there is a need to strengthen trade relationships with traditional partners, which Iranian ports can manage by focusing more on domestic cargo.

# CHAPTER 8: CONCLUSION

## 8.1. FINDINGS

Given the role of seaports as nodes in the multimodal transport and logistics system, logistics integration is essential to not only their performance and but also the performance of the multimodal transport and logistics system. Having said that, logistics integration involves collaboration between actors in the transport and logistics system and the supply chains. Such collaboration typically covers a range of activities from investment, value-adding service offerings, to communication. And yet, limited research has been dedicated to this topic.

The main aim of this study is to explore how ports may improve their logistics integration using a case study of Iranian ports. As explained in Chapter 1 regarding the research objective and research questions, the study seeks to identify the key factors in port logistics integration, investigating how they are implemented in the Iranian port sector as well as the issues in logistics integration and the implications for port management.

To identify the factors influential in port logistics integration, a review of existing studies on the topic was conducted. Seven factors were identified including resource sharing, organisational activities, institutional support, information and communication integration, value-added services, processes and operations, and logistics practices. Based on the literature review, a conceptual framework for port logistics integration was developed and applied to the case study of logistics integration in Iranian ports. The data sample covered 212 senior staff and managers from the sector. Quantitative data collected were from Likert-scale survey questions, and qualitative data were collected from open-ended survey questions and interviews.

In the quantitative analysis, both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were carried out using SPSS and AMOS software. The findings show a clear understanding of the most influential factors of port logistics integration and the associated challenges in the Iranian port sector. Specific areas in Iranian port management were identified for each of the seven factors.

The first factor pertains to resource sharing. Sharing resources is an essential part of logistics integration, allowing for ports and their partners to gain operational efficiency through the optimal use of their resources. These include, for example, the shared use of port infrastructure and warehousing facilities, shipping containers, shippers' special knowledge, skills and equipment for packaging, consolidation and deconsolidation. As detailed in Chapter 7, the study found that ports and their partners can share their resources for this purpose in four key areas, namely joint development of packaging, optimal procurement process, optimal subcontracting, and involving industry partners in the decision-making process. The second factor is institutional support. The study identified four areas where support is needed for Iranian ports, namely loan approval, financial support, leasing of facilities and equipment, research and development of best practices. These financial facilities, including business loans/microcredit with lower interest rates, are vital as port operations are capital intensive. The third influential factor in Iranian port logistics integration is organisational activities, encompassing teamwork, interpersonal trust and customer-oriented policy.

The fourth factor refers to value-adding services, which are necessary to ensure ports are able to meet different needs from port users for logistics services. This, in turn, requires that ports have sufficient capacity and facilities for value-adding services such as the inventory management system, warehouses and utility services. Alternatively, a port can run value-adding service operations through its partnership with industry partners. Moreover, they need to be able to respond to market demand. The fifth factor in logistics integration concerns the operational procedure and process. The study identified modal shift, transport planning and management, development of a partnership for better service quality and reducing distribution costs.

The sixth factor concerns ports' good practices in logistics operations, especially in three specific areas as indicated by the findings, namely transport connectivity with the hinterland, transport efficiency and cost savings. The seventh factor is information and communication integration. Iranian ports should make use of available information and communication technologies and their extensive applications in transport and logistics operations. The study identified two specific areas relevant to this factor, namely the use of online transactions, bookings and EDI applications.

The qualitative analysis found various challenges facing Iranian seaports in logistics integration. One of the biggest challenges is insufficient infrastructure for which the Iranian government is responsible as ports are managed by state-owned companies. In addition to insufficient government funding, the ports have been let down by a lack of participation from the private sector. International companies find it hard to participate in the sector because of legal restrictions imposed by the government on one hand and by economic and political sanctions on the other hand. This leads to the second challenge facing the sector that is insufficient access to rail transport (as in the case of Shahid Rajaee and Chabahr ports). As a result, inland transport has had to rely on road transport, which is inefficient. Another major challenge relates to port management and governance. Since ports are state-owned, they are not able to respond to market conditions and needs. Skills shortages in Iranian ports has resulted in poor service quality, achieving an average score of 2.6 out of 5. Thus, the sector would need to overcome these challenges as it tries to improve logistics integration, which is much of a chicken and egg problem. Nevertheless, it is hoped that, given the country's rich natural resources and strategic location, the sector would be able to take advantage of its strategic location in the Middle East region and its existing trade relationships with traditional partners at times when oil prices are likely to increase in favour the country's rich oil reserve.

## 8.2. CONTRIBUTIONS

The literature has found positive impacts of logistics integration on different aspects of port operations, such as organisational performance (Stock *et al.* 2000), logistics performance (Rodrigues *et al.* 2004), business performance (Robertson 2006), inbound supply performance (Prajogo *et al.* 2015), operational performance (Prajogo & Olhager 2011), firm performance (Narayanan *et al.* 2011), financial and market performance (Mellat-Parast & Spillan 2014b), and supply chain performance (Alam, Bagchi, *et al.* 2014). Despite the importance of logistics integration in port management, research on this topic is limited and no study has been found on the Iranian port sector. This study attempts to contribute to filling this gap in the literature from both theoretical and practical perspectives as mentioned below.

### 8.2.1. Theoretical contributions

In terms of theoretical implications, the current study proposed a conceptual framework to analyse port logistics integration. The main theoretical contribution of this study is the development of a conceptual framework in logistics integration in general and for the port sector in particular. In order to address the research gaps mentioned in Chapter 1, the study considered logistics integration in different contexts such as those of the manufacturing, agricultural, service and maritime sectors before their differences and similarities in terms of influential factors, functions and actors involved in the logistics chain are studied. Considering characteristics of the port logistics chain, the study used developments agricultural and manufacturing logistics integration and applied them in the port logistics chain context. In this study, the concept of logistics integration was extended to allow for both ‘actor integration’ through collaboration and partnership with logistics partners, and ‘functional integration’ through logistics operations such as resource sharing, logistics process and operational practices. These theoretical contributions were then tested through empirical research using data collected from the Iranian port sector.

As shown in Chapter 7 and the previous section, this study not only considered the key factors in logistics integration but also specific areas concerning each of those factors. These areas were identified through EFA, then confirmed through CFA and then were used as a basis to provide recommendations for Iranian port management.

This study seeks to redefine logistics integration in the port context by exploring the different perspectives of shipping lines, port authorities, transport companies, logistics service providers and other actors. It highlights the role of organisational activities, resource sharing and institutional support in addition to its operational and informational factors, considering the importance of organisational and institutional factors in logistics integration (Alfalla-Luque, Medina-Lopez & Dey 2013; Pinmanee 2016). The study findings will benefit research on supply chain and logistics management.

The case study of Iran is noteworthy as a country with unique social, economic and political conditions. At the same time, it is also subject to a number of issues facing a transitional economy. In this regard, the study’s findings may be helpful to ports in other transitional countries.

### 8.2.2. Practical contributions

The study’s findings also have practical contributions to the industry, policy makers and port management. The identification of the factors in port logistics integration allows port management to identify areas that need improvement and develop strategies and plans to improve the port’s integration with other logistics providers. The analysis results indicate that in today’s competitive market, port operators are not the only actors responsible for integrating the port functions and activities like the traditional perspective. For example, information sharing, resource sharing, institutional support and other factors should be managed by all actors in the logistics chain (Song & Panayides 2008).

The study also highlights the important role of intra and inter organisational relationships, collaboration and communication in logistics integration. In order to achieve the aforementioned practices, this study suggests that managers encourage teamwork between employees, implement CRM strategies, sign long-term contracts with logistics partners and prioritise the organisational decisions based on interests of all stakeholders. It is also recommended that logistics chain partners apply new ICT tools, such as artificial intelligence (AI), big data, internet of things (IoT), block chains, cloud computing into aid logistics integration and operations management.

Given the critical role of the Iranian government and port authorities, institutional support is indispensable to the port sector in logistics integration. This includes financial support from the government to provide sufficient physical capital through investment in port infrastructure such as warehouses, IT and shipping equipment. Moreover, the study suggests that managers organise training and educational activities for employees to improve the knowledge of logistics and supply chain among staff to increase the efficiency of the logistics chain.

The knowledge gained through this study can help managers/policy makers/port authorities promote and better understand the need for value-added services provided by Iranian ports which are currently in a weak position compared to neighbouring countries. This study suggests that port managers develop facilities such as real-time inventory management tools, cross-docking, warehouses, repackaging and redesigning centres alongside the ports or develop dry ports which are the requirements for new regeneration of the ports.

The revelation of challenges facing the sector found by the study suggests the need for investment in infrastructure development in different parts of port logistics. One of the biggest challenges is the unclarity of responsibilities in terms of budget allocation to develop the infrastructure. The study suggests the need for managers to focus and become more involved in the planning and using of resources including budgets, loans or any financial support for port development, specifically in the road and rail sectors which were found to be the bottlenecks in port logistics. Another suggestion for port managers is to revise the port tariffs and terminal charges system. For instance, port charges and tariffs could be calculated based on engine power and operating hours, flexible pricing (e.g. discount for frequent customers), port marketing and promotional campaigns.

The findings of this research also have several implications for policy makers, port managers and port users outside of Iranian context. Port managers can use the proposed framework for benchmarking purposes in order to identify whether or not a port logistics integration is consistent with the expectations from different actors in the logistics chain. Therefore, the framework allows port managers to identify the relevant variables and factors that logistics chain actors and users need to be aware of. Moreover, it can also be helpful to identify challenges and provides insights as to which parameters the port needs to improve upon. In the large context, the framework can be used to rank the port logistics in different regions such as the Middle East.

The study also provides port management with an insight into port logistics integration including its critical elements and obstacles. Making short-term and long-term strategic plans to overcome the challenges and using suggestions for improvement from respondents will help policy makers and authorities to advance logistics integration. The study's practical implications are not only limited to the port and maritime context. Logistics and supply chain managers can also extend or modify the proposed framework according to their operational and organisational context or use it to analyse the integration level of their logistics system.

## 8.3. RESEARCH LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

This study is subject to a number of limitations. The first limitation is related to the sample size. In particular, stratified random sampling was applied to collect data from port users such as shipping lines, transport companies, port operators, and logistics service providers. The number of respondents was small from some actors such as import and export companies, logistics service providers as well as rail and truck companies and terminals. Due to the unavailability of some of logistics chain partners, the numbers of responses across sub-sectors are not homogenous. Thus, separating the participants into their respective groups would result in small subsamples, making it unsuitable to use factor analysis for individual groups.

Second, due to the multi-faceted nature of the research topic that involves a potentially large number of variables and factors, the study could not cover all identified items in the literature. For example, in information integration, the study only asked about the items that were completely fit within the scope of the study.

Third, due to time constraints, data collecting was carried out over a fixed period of time. Longitudinal research could not be conducted to observe how perceived factors change over time. In addition, due to limitations in the data collection and the lack of specific bulk or container ports in Iran, the study investigates logistics integration for all types of cargo collectively rather than each type of cargo individually. Because of the different characteristics of the container and bulk cargo, focusing on both types of cargo and comparing their results could have produced more insightful results.

Fourth, due to the restrictions in collecting data, the data collection only conducted in one round using the parallel mix method. However, exploratory sequential mix method may have better results in identifying challenges in port logistics integration. Fifth, due to the variations in the size of the sectors and unavailability of some of the logistics chain partners, the numbers of responses are different across sectors.

Given the above limitations, it is recommended that future studies apply the proposed conceptual framework to other countries. Although the framework can be adapted to different port logistics systems around the world, it is more useful for countries with conditions similar to the Iranian economy and port sector. It is also recommended to apply the framework to other sectors such as airlines and road transportation. Future research could evaluate the effect of the seven factors on port logistics integration. In addition, future studies can attempt an in-depth discussion on the inter-relationships between the port logistics chain variables using data analysis tools. Moreover, the effect of each factor could be analysed based on various actors' perspectives. For instance, for large-scale analysis, the effect of value-added services could be considered for different parts of the logistics chain from different chain actors' perspectives. Such a study could sample an equal number of participants for each perspective, thereby enabling an unbiased discussion for each chain actor. Future research may also study the effect of logistics integration on various performance indicators, such as quay crane, yard equipment productivity, ship and truck turnaround time, and dwell time in the container yard. This study considered organisational activities and institutional integration to analyse the relationships between actors in the logistics chain which has been rarely discussed in the extant literature and in the context of the port sector. According to the analysis results, these variables were identified as strong factors influencing port logistics integration. Therefore, due to the complicated relationships between actors in recent years, the study strongly suggests that future studies consider these factors individually to enable an in-depth discussion of their effects on logistics integration. The current study used statistical analysis and qualitative analysis to investigate port logistics integration from a managerial perspective. Future studies can focus on the operational perspective of the logistics chain and use mathematical models or simulation tools.

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# APPENDIXES

# APPENDIX A ETHICS APPROVAL

Social Science Ethics Officer
Private Bag 01 Hobart
Tasmania 7001 Australia
Tel: (03) 6226 2763
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Katherine.Shaw@utas.edu.au

HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

UTAS

07 June 2017

Dr Oanh Nguyen
Department of Maritime and Logistics Management
Australian Maritime College
University of Tasmania

Student Researcher: Ali Alavi

*Sent via email*

Dear Dr Nguyen

Re: MINIMAL RISK ETHICS APPLICATION APPROVAL
Ethics Ref: **H0016624 - Logistics Integration in the Port Sector: the Case of Iran**

We are pleased to advise that acting on a mandate from the Tasmania Social Sciences HREC, the Deputy Chair of the committee considered and approved the above project on 06 June 2017.

This approval constitutes ethical clearance by the Tasmania Social Sciences Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approval of other bodies or authorities is required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

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2. Complaints: If any complaints are received or ethical issues arise during the course of the project, investigators should advise the Executive Officer of the Ethics Committee on 03 6226 7479 or human.ethics@utas.edu.au.

3. Incidents or adverse effects: Investigators should notify the Ethics Committee immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.

4. Amendments to Project: Modifications to the project must not proceed until approval is obtained from the Ethics Committee. Please submit an Amendment Form (available on our website) to notify the Ethics Committee of the proposed modifications.

5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. **Failure to submit a Progress Report will mean that ethics approval for this project will lapse.**

6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely

Katherine Shaw
Executive Officer
Tasmania Social Sciences HREC

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# APPENDIX B1 COVER SHEET

### Logistics Integration in the Port Sector: The Case of Iran

Dear Sir/Madam,

Thank you for your valuable time. You are invited to participate in a voluntary survey, which is the major part of PhD research focusing on **port logistics integration in Iranian seaports**. The main aims of this research are to:

- identify the key factors influential to port logistics integration;
- provide an analysis of logistics integration in the Iranian seaport sector and recommendations for policy makers and port management.

Port logistics integration is about well-coordinated relationships with port logistics actors and the improvement of functional activities in the port environment in order to create value to port services and facilitate the efficient handling of cargoes.

You will be asked to answer questions regarding your business, your business relationships with your suppliers/customers/service providers and your supply chain/logistics. All individual responses collected through this survey, including the results, will be treated as **strictly confidential** and the **anonymity** of companies and individuals is assured. Your answers will only be used for research purposes and reported in a statistical form. For your assurance, the Tasmanian Social Science Human Research Ethics Committee (HREC) has approved this survey, reference number H0016624. If you have any concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +61 3 62266254.

The survey will take approximately **30 minutes** of your time to complete. Your participation in this study is entirely voluntary and you have the right to withdraw at any time, without consequence. If you have any questions or would like further information, please do not hesitate to call or email Ali Alavi (Mr) at the contact details provided below.

Your participation will make a valuable contribution towards a better understanding of port logistics integration and help to improve Iranian port logistics systems.

If you agree to participate, please tick the box and continue with the survey. ☐

Thank you in advance for your valuable contribution.

Yours faithfully,

Ali Alavi
PhD Candidate in Supply Chain and Logistics Management
Launceston Hub | Australian Maritime College
Connell Building | Room 58
University of Tasmania | Launceston TAS 7250
T +61 4984 49203 | ali.alavi@utas.edu.au

# APPENDIX B2 INFORMATION SHEET

PARTICIPANT INFORMATION SHEET

## Logistics Integration in the Port Sector: The Case of Iran

This research project aims to identify influential factors in port logistics integration in Iranian seaports and the challenges in integrating the port logistics system. This study is being conducted in partial fulfilment of a PhD degree by Mr Ali Alavi under the supervision of Dr Hong-Oanh Nguyen, Dr Jiangang Fei and Dr Jafar Sayareh from the Department of Maritime and Logistics Management, Australian Maritime College, University of Tasmania.

**2. What is the purpose of this study?**

The main purpose of this research is to propose a conceptual framework to analyse port logistics integration in general and for the Iranian port sector in particular, including consideration of the challenges, outcomes and opportunities in implementing port logistics integration. The aim of the research can be divided into two main objectives:

- To identify the key factors influential to port logistics integration;
- To provide an analysis of logistics integration in the Iranian seaport sector and recommendations for policy makers and port management.

**3. Why have I been invited to participate?**

You have been invited to participate in this study as a member of the Iranian seaport logistics chain.

Please be assured that your involvement is voluntary and there will be no consequences if you decide not to participate. However, your participation will be a great contribution towards a better understanding of information sharing between supply chain partners and its effect on supply chain performance in Iran.

**4. What will I be asked to do?**

You will be asked to participate either in a survey or both survey and interview that investigates your views, opinions, and experience regarding logistics integration in the Iranian port sector. You will be asked a series of scaled questions in the survey which is anticipated to take approximately 30 minutes. For each question, please place a tick ( √ ) in the box (□) according to your view and knowledge about the subject matter. You can choose to complete the survey online, via email or by using the hard copy of the questionnaire.

The interview will take approximately 30 minutes of your time. If you agree to participate in the interview, you will be asked to sign a consent form giving the researcher permission to collect the necessary information and use it for research purposes.

All the information that you provide will be treated as strictly confidential, and your personal details will not be used in any publication arising from this research. However, we respect your right to decline.

**5. Are there any possible benefits from participation in this study?**

This study aims to contribute to a better understanding of logistics integration in the Iranian port sector and how it can be improved. It will help managers and decision makers to develop strategies to promote logistics systems in terms of integrity.

For the benefit of the participants, a copy of the survey summary, results and articles out of this study will be available upon request according to clause No. 4.3 of the Australian Code for the Responsible Conduct of Research.

**6. Are there any possible risks from participation in this study?**

There are no specific risks anticipated with participation in this study.

**7. What if I change my mind during or after the study?**

Your participation in this study is voluntary. While your participation will be greatly appreciated, we will respect your decision to decline or withdraw. You are free to withdraw at any time without providing an explanation. You will also have the right to ask that any data you have provided to date be removed from the study within 28 days after the survey/interview.

**8. What will happen to the information when this study is over?**

Hard copies of all the data collected from this study (transcripts of interviews, audio recordings and responses to the questionnaire) will be stored in a locked filing cabinet in a locked office at the National Centre of Ports and Shipping (NCPS), Department of Maritime and Logistics Management, Australian Maritime College, University of Tasmania. Electronic data will be stored on a secure server of the University of Tasmania and password protected. The stored data will not bear participants' names or be identifiable after the completion of the project. According to the research requirements (clause No. 2.1 of the Australian Code for the Responsible Conduct of Research), all data will be kept for a maximum of 5 years following the publication of reports or articles resulting from the generated data, after which they will be securely destroyed.

**9. How will the results of the study be published?**

The results will be published in a PhD thesis. The findings from the study may also be published or presented at conferences and in other academic contexts, including scientific journals. According to clause No. 4.3 of the Australian Code for Responsible Conduct of Research, the results of the study will be also available for participants and the wider public.

**10. What if I have questions about this study?**

If you have any questions about this study or if you wish to discuss any aspects regarding this research, please do not hesitate to contact any of the following people:

**Chief Investigator:**
Dr Hong-Oanh (Owen) Nguyen
Department of Maritime and Logistics Management
Australian Maritime College | University of Tasmania
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**Student Investigator:**
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The Tasmanian Social Science Human Research Ethics Committee (HREC) has approved this study. If you have any concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +61 3 6226 6254 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number … . Both HREC and the researcher consider this option essential to preserving your rights under the 2007 Australian Code for the Responsible Conduct of Research, sections 1.6–1.8 (detailing researcher responsibilities towards research and participants and section 2 (detailing the requirement for researcher responsibilities towards safeguarding research data and primary materials). Similar researcher responsibilities are outlined in section 1 of the updated May 2015 version of the 2007 Australia National Statement on Ethical Conduct in Human Research, along with the ethical responsibilities of researchers under the University of Tasmania Research Ethics Policy, section 3. These codes are viewable online on the University of Tasmania website and a full copy can be emailed to you by this researcher if required.

**Thank you for your time.**
**This information sheet is for you to keep.**
**If you wish to take part in the study, please sign the attached consent form.**

# APPENDIX B3 INVITATION LETTER

**Invitation to Participate in a Survey/Interview about Port Logistics Integration in Iranian Seaports**

Dear Sir/Madam,

My name is Ali Alavi and I am currently conducting research into logistics integration in Iranian ports in partial fulfilment of my Doctor of Philosophy Degree (PhD) at the Australian Maritime College, University of Tasmania, Australia. The focus of this research is to identify the influential factors in port logistics integration and the challenges facing port logistics integration in Iran.

As your insights are expected to be highly relevant to this research, I kindly invite you to participate in a survey/interview that will assist me in gaining a deep understanding of the status of port logistics integration in Iran.

It is anticipated that the survey/interview would require approximately 30 minutes of your time. All individual responses collected through the survey/interview, including the results, will be treated as **strictly confidential** and the **anonymity** of companies and individuals is assured. This research has been granted Social Research Ethics Approval No. …

If you agree to participate, please sign the attached consent form. While your participation is very important for this study, we will respect your decision to decline or withdraw. Your participation is entirely voluntary, and you are free to withdraw at any time without providing an explanation. For the benefit of the participants, a copy of the survey summary will be available upon request.

If you have any queries, please do not hesitate to email me at ali.alavi@utas.edu.au or call me on +61 498449203.

Yours faithfully,

Ali Alavi
PhD Candidate in Supply Chain and Logistics Management
Launceston Hub | Australian Maritime College
Connell Building | Room 58
University of Tasmania | Launceston TAS 7250
T +61 4984 49203 | ali.alavi@utas.edu.au

# APPENDIX B4 PARTICIPANT CONSENT FORM

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PARTICIPANT CONSENT FORM

## Logistics Integration in the Port Sector: The Case of Iran

This consent form is for use by those willing to participate in the research study 'Logistics Integration in the Port Sector: The Case of Iran'.

Participants may withdraw any time during or after the interview.

1. I agree to take part in the research study named above.
2. I have read and understood the Information Sheet for this study.
3. The nature and possible effects of the study have been explained to me.
4. I understand that the study involves my participation in a face-to-face interview for approximately 30-45 minutes, which will be recorded with my consent for future reference.

   I agree to have the interview voice recorded. Yes ☐ No ☐
5. I understand that there are no specific risks anticipated with my participation in this study.
6. I understand that all research data and information will be stored safely in a locked cabinet at the University of Tasmania premises for five years from the publication of the study results and will then be destroyed.
7. Any questions that I have asked have been answered to my satisfaction.
8. I understand that the researcher(s) will maintain confidentiality and that any information that I supply to the researcher(s) will be used only for the purposes of the research.
9. I understand that the results of the study will be published in such a way that I cannot be identified as a participant.

10. I understand that my participation is voluntary and that I may withdraw at any time without any effect.

11. I understand that I will be able to withdraw any data that I have supplied any time during or after the interview/survey.

Participant's Name: ____________________________________________

Participant's Signature: ________________________________________

Date: _________________________________________________________

**Statement by Investigator**

☐ I have explained the project and the implications of participation to this participant and I believe that he/she understands the implications of participation.

If the investigator has not had an opportunity to talk to the participants prior to their participation, the following box must be ticked.

☐ The participant has received the Information Sheet, which includes the contact details of the investigator so that they can contact the investigator before giving his/her consent for participation.

Investigator's Name: _____________________________________________

Investigator's Signature: __________________________________________

Date: ____________________________________________________________

# APPENDIX C QUESTIONNAIRE

## Questionnaire:

## Logistics Integration in the Port Sector: The Case of Iran

### 1. Respondent's profile

**1.1. Type of service:**

☐ Port authority ☐ Terminal ☐ Stevedoring ☐ Warehousing

☐ Shipping company ☐ Land transport (road & rail) ☐ Logistics/Freight forwarding

☐ Export/Import ☐ Manufacturing ☐ Other

**1.2. Please indicate the number of years you have been in this position.**

☐ Less than 5 years ☐ 5–9 years ☐ 10–19 years ☐ 20 years and over

**1.3. Please indicate your in the company.**

☐ Chief Executive Officer (CEO) ☐ General manager/Senior manager

☐ Division manager ☐ Business owner ☐ Senior expert ☐ Other

**1.4. Please indicate the name of the port(s) with which you are familiar.**

……………………….

## 2. Port logistics integration

Please rate the importance of the following statements in the context of Iranian seaports. Please tick the box to indicate the level of importance.

(1 = Not important, 2 = Slightly important, 3 = Moderately important, 4 = Important, 5 = Very important)

| Item No. | Survey Items | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **2.1** | **Information and Communication Integration** | | | | | |
| 2.1.1 | Regular communication with relevant logistics/supply chain partners | □1 | □2 | □3 | □4 | □5 |
| 2.1.2 | Sharing useful information with relevant logistics/Supply Chain partners | □1 | □2 | □3 | □4 | □5 |
| 2.1.3 | Using modern ICT facilities and devices (e.g. landline phone, fax, mobile, smart phone, computer, software) can help cargo distribution become more visible to know exact customer demand | □1 | □2 | □3 | □4 | □5 |
| 2.1.4 | Using advanced IT to control container flow | □1 | □2 | □3 | □4 | □5 |
| 2.1.5 | Using advanced IT to book space for containers online | □1 | □2 | □3 | □4 | □5 |
| 2.1.6 | Using databases to share supply chain information electronically (not paper-based) | □1 | □2 | □3 | □4 | □5 |
| 2.1.7 | High level of accuracy of the shared information | □1 | □2 | □3 | □4 | □5 |
| 2.1.8 | Using a high level of website transaction with partners (such as e-documentation, tracking and tracing of shipping sequence/status) | □1 | □2 | □3 | □4 | □5 |
| 2.1.9 | Adopting electronic data interchange (EDI) to improve transport operation efficiency with logistics chain partners | □1 | □2 | □3 | □4 | □5 |
| **2.2** | **Value Adding Services** | | | | | |
| 2.2.1 | Adequate facilities for adding value to cargoes (such as inventory management, distribution centre and warehousing facilities) | □1 | □2 | □3 | □4 | □5 |
| 2.2.2 | Value added logistics storage equipment (e.g. pre-assembly, manufacturing, packaging) | □1 | □2 | □3 | □4 | □5 |
| 2.2.3 | Using maintenance and repair facilities for containers, reefer units | □1 | □2 | □3 | □4 | □5 |
| 2.2.4 | Involving the partners in the development process | □1 | □2 | □3 | □4 | □5 |
| 2.2.5 | Create mutual value for targeted consignees by aligning the partners | □1 | □2 | □3 | □4 | □5 |
| 2.2.6 | Capacity to convey cargo through the most diversified routes/modes in the least possible time to consignee's premises | □1 | □2 | □3 | □4 | □5 |
| 2.2.7 | Making quick decisions regarding changing design processes to meet customers' demand | □1 | □2 | □3 | □4 | □5 |

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| | | |
|---|---|---|
| **2.3** | **Process and Operations** | |
| 2.3.1 | Level of modal shift among different modes of transportation | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.3.2 | Using intelligent clearance (using e-clearance) at checkpoints | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.3.3 | connectivity/operability for ship/road or ship/rail interface | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.3.4 | Joint transport planning, management and control processes for cargo distribution with other logistics firms | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.3.5 | Make a contract with partners for a quality service level for reducing distribution costs in cargo delivery | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.3.6 | Provide safer, more reliable and integrated services to improve security of transport | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.3.7 | Relationship based on mutual trust and commitment | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.3.8 | Schedule precise and accurate transfer times | ☐1 ☐2 ☐3 ☐4 ☐5 |
| **2.4** | **Logistics Practices and Performance** | |
| 2.4.1 | Evaluating alternative routes for increasing transport efficiency | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.4.2 | Collaboration with channel members for channel optimisation | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.4.3 | Benchmark logistics/supply chain management options in relation to competing ports | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.4.4 | Identifying least-cost options for transport of cargoes to hinterland destinations | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.4.5 | Identify transport modes for linking port/terminal to its hinterland destinations | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.4.6 | Integrated promotion activities for the port (advertising and encouraging customers) | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.4.7 | Offering support for customers to choose their preferred channel and complete their purchases | ☐1 ☐2 ☐3 ☐4 ☐5 |
| **2.5** | **Organisational Activities** | |
| 2.5.1 | Sharing risks, costs and rewards (operational and strategic collaboration) | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.5.2 | Building interpersonal trust to create/maintain long-term relationships with other distribution partners through keeping promises and respecting agreements with partners such as delivery date, and quantity and quality of cargos | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.5.3 | Guiding organisations towards a joint search for end-customer satisfaction | ☐1 ☐2 ☐3 ☐4 ☐5 |

| | | |
|---|---|---|
| 2.5.4 | Building interpersonal trust to create/maintain long-term relationships with other distribution partners through keeping the interests of all stakeholders in mind | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.5.5 | Encouraging teamwork within internal cross-functional teams through providing training for employees so that they can work in diverse situations | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.5.6 | Encouraging teamwork within internal cross-functional teams through enhancing teamwork in cargo distribution by placing a new employee into an existing team whose members are experienced | ☐1 ☐2 ☐3 ☐4 ☐5 |
| **2.6** | **Institutional Support** | |
| 2.6.1 | Research for identifying and implementing the best practices in freight transport | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.6.2 | Financial support for logistics providers to build new facilities | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.6.3 | Approving business loans/microcredit facilities with lower interest rates | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.6.4 | Facilitating leases (i.e. vehicle, warehouse, IT, shipping equipment) with the aim of improving logistics of cargo distribution | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.6.5 | Understanding and assessing inter-relationships among logistics functions | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.6.6 | Providing vocational education for identifying and defining logistics strategies in cargo distribution | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.6.7 | Organising, inviting and assisting participation in seminars, conferences and symposia, where innovations in the development of cargo distribution can be disseminated and discussed | ☐1 ☐2 ☐3 ☐4 ☐5 |
| **2.7** | **Resource Sharing** | |
| 2.7.1 | Involving the supply chain members in decision making to determine the best negotiating position | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.7.2 | Searching for optimal subcontracting for the entire supply chain, with special emphasis on logistics providers | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.7.3 | Design and joint development of packaging to facilitate handling and transport of received cargos | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.7.4 | Shared use of containers to facilitate handling operations | ☐1 ☐2 ☐3 ☐4 ☐5 |
| 2.7.5 | Searching optimisation in the procurement and distribution of cargos throughout the supply chain | ☐1 ☐2 ☐3 ☐4 ☐5 |

### 3. Challenges in Iranian port logistics integration

This section seeks your views on challenges in Iranian port logistics integration. Please tick the box to indicate the extent to which you AGREE or DISAGREE with the following statements.

(1 = Strongly disagree, 2 = Disagree, 3 = No opinion or uncertain, 4 = Agree, 5 = Strongly agree)

| Item No. | Survey Items | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **3.1** | **Infrastructure** | | | | | |
| 3.1.1 | Insufficient investment in ports | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.1.2 | Lack of appropriate infrastructure in ports logistics and transportation systems | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.1.3 | Lack of a comprehensive plan for development in ports | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **3.2** | **Governance and Policy** | | | | | |
| 3.2.1 | Impact of the global economic crisis on Iranian shipping | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.2.2 | Insecurity in waters where pirates are active | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.2.3 | Lack of support for development strategies from different levels of government | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **3.3** | **Operational/Technical** | | | | | |
| 3.3.1 | The disintegration of the ports in the north and south | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.3.2 | Oversupply in busy ports which leads to bottlenecks | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.3.3 | Poor freight distribution systems | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.3.4 | High terminal charges | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.3.5 | Lack of coordination in port activities, especially in the receiving, maintenance and clearance sectors | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.3.6 | Poor information access in the port industry | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **3.4** | **Managerial/Organisational** | | | | | |
| 3.4.1 | Rigidity of the laws and regulations governing maritime transport | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.4.2 | Lack of integrated supply chain thinking in the port industry | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.4.3 | Poor customer relationship management | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.4.4 | Shortage of skilled human resources | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **3.5** | **Sanctions** | | | | | |
| 3.5.1 | Economic international sanctions | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.5.2 | Problems with Financial transactions in import and export | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.5.3 | Problems with investment and securing financial credit from banks for international shipping companies | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3.5.4 | Unwillingness of financial institutions and credit institutions to invest | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

### 4. Overall level of logistics integration in Iranian ports

Overall, how do you rate the level of logistics integration in Iranian ports?

☐ Very low ☐ Low ☐ Moderate ☐ High ☐ Very high

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## 5. Open-ended questions

5.1. What are the challenges facing logistics integration in Iranian ports?

5.2. How can Iranian seaports improve port logistics integration?

5.3. Over the next five to ten years, how do you see the role of Iranian ports in comparison with neighbouring countries' ports?

5.4. How do you think the sanctions removal will affect the Iranian seaports in the future?

5.5. Finally, are there any other recommendations for integrating logistics systems and overcoming the challenges in Iranian seaports?

Thank you for the valuable time and attention that you have committed to answering the questions. If there are any additional concerns, if you would like further information and/or a copy of this research once completed and supervisor approved prior to submission as a thesis, please feel free to contact the principal field investigator Ali Alavi at Ali.alavi@utas.edu.au or (+61) 04

6

# APPENDIX D EXPLORATORY FACTOR ANALYSIS- PLI

**Descriptive Statistics**

| | Mean | Std. Deviation | Analysis N |
|---|---|---|---|
| RS3 | 3.9292 | .78474 | 212 |
| RS5 | 4.0189 | .72832 | 212 |
| RS2 | 3.8821 | .77292 | 212 |
| RS4 | 3.8726 | .77753 | 212 |
| IS3 | 3.9575 | .83926 | 212 |
| IS4 | 3.8962 | .72764 | 212 |
| IS2 | 3.9906 | .73498 | 212 |
| IS1 | 4.1132 | .73917 | 212 |
| OA6 | 3.8915 | .73667 | 212 |
| OA5 | 4.0000 | .70206 | 212 |
| OA4 | 3.9245 | .73759 | 212 |
| OA3 | 4.0283 | .74729 | 212 |
| VAS2 | 3.8349 | .75796 | 212 |
| VAS7 | 4.0283 | .75986 | 212 |
| VAS4 | 3.9340 | .73205 | 212 |
| VAS1 | 3.9670 | .68418 | 212 |
| PO1 | 3.7830 | .75419 | 212 |
| PO4 | 4.0425 | .72405 | 212 |
| PO5 | 3.9670 | .73751 | 212 |
| LP5 | 4.0613 | .72922 | 212 |
| LP4 | 4.0613 | .76723 | 212 |
| LP1 | 4.0991 | .71848 | 212 |
| LP6 | 4.0189 | .74122 | 212 |
| II8 | 4.2311 | .71436 | 212 |
| II5 | 4.2406 | .70453 | 212 |
| II9 | 4.1840 | .66684 | 212 |

**KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .866 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 1529.286 |
| | df | 325 |
| | Sig. | .000 |

**Communalities**

| | Initial | Extraction |
|---|---|---|
| RS3 | 1.000 | .568 |
| RS5 | 1.000 | .519 |
| RS2 | 1.000 | .577 |
| RS4 | 1.000 | .695 |
| IS3 | 1.000 | .682 |
| IS4 | 1.000 | .603 |
| IS2 | 1.000 | .597 |
| IS1 | 1.000 | .605 |
| OA6 | 1.000 | .543 |
| OA5 | 1.000 | .628 |
| OA4 | 1.000 | .495 |
| OA3 | 1.000 | .500 |
| VAS2 | 1.000 | .580 |
| VAS7 | 1.000 | .573 |
| VAS4 | 1.000 | .463 |
| VAS1 | 1.000 | .358 |
| PO1 | 1.000 | .561 |
| PO4 | 1.000 | .476 |
| PO5 | 1.000 | .501 |
| LP5 | 1.000 | .680 |
| LP4 | 1.000 | .672 |
| LP1 | 1.000 | .444 |
| LP6 | 1.000 | .468 |
| II8 | 1.000 | .700 |
| II5 | 1.000 | .649 |
| II9 | 1.000 | .594 |

Extraction Method: Principal Component Analysis.

**Total Variance Explained**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.911 | 26.580 | 26.580 | 6.911 | 26.580 | 26.580 | 2.489 | 9.572 | 9.572 |
| 2 | 1.602 | 6.160 | 32.740 | 1.602 | 6.160 | 32.740 | 2.361 | 9.079 | 18.651 |
| 3 | 1.443 | 5.552 | 38.291 | 1.443 | 5.552 | 38.291 | 2.094 | 8.053 | 26.704 |
| 4 | 1.343 | 5.164 | 43.455 | 1.343 | 5.164 | 43.455 | 2.034 | 7.823 | 34.527 |
| 5 | 1.263 | 4.859 | 48.314 | 1.263 | 4.859 | 48.314 | 1.987 | 7.641 | 42.167 |
| 6 | 1.156 | 4.445 | 52.759 | 1.156 | 4.445 | 52.759 | 1.954 | 7.515 | 49.683 |
| 7 | 1.013 | 3.895 | 56.655 | 1.013 | 3.895 | 56.655 | 1.813 | 6.972 | 56.655 |
| 8 | .991 | 3.812 | 60.467 | | | | | | |
| 9 | .911 | 3.502 | 63.969 | | | | | | |
| 10 | .889 | 3.421 | 67.389 | | | | | | |
| 11 | .766 | 2.947 | 70.337 | | | | | | |
| 12 | .742 | 2.852 | 73.189 | | | | | | |
| 13 | .731 | 2.813 | 76.001 | | | | | | |
| 14 | .676 | 2.600 | 78.602 | | | | | | |
| 15 | .641 | 2.465 | 81.066 | | | | | | |
| 16 | .609 | 2.343 | 83.409 | | | | | | |
| 17 | .579 | 2.227 | 85.636 | | | | | | |
| 18 | .526 | 2.021 | 87.657 | | | | | | |
| 19 | .509 | 1.959 | 89.616 | | | | | | |
| 20 | .486 | 1.868 | 91.483 | | | | | | |
| 21 | .440 | 1.692 | 93.175 | | | | | | |
| 22 | .404 | 1.554 | 94.729 | | | | | | |
| 23 | .387 | 1.490 | 96.219 | | | | | | |
| 24 | .353 | 1.359 | 97.578 | | | | | | |
| 25 | .327 | 1.258 | 98.836 | | | | | | |
| 26 | .303 | 1.164 | 100.000 | | | | | | |

Extraction Method: Principal Component Analysis.

## Component Matrix[a]

| | Component | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| RS3 | .545 | | | -.407 | | | |
| RS5 | .541 | | | -.349 | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| RS2 | .609 | | | | | | |
| RS4 | .477 | | .328 | | | .436 | -.344 |
| IS3 | .545 | -.414 | | .384 | | | |
| IS4 | .489 | | | .382 | | | |
| IS2 | .519 | | | .477 | | | |
| IS1 | .663 | | | | | | |
| OA6 | .507 | | | | | | .395 |
| OA5 | .586 | | | | -.333 | | |
| OA4 | .516 | | | | | | .368 |
| OA3 | .643 | | | | | | |
| VAS2 | .439 | | .404 | | | -.334 | |
| VAS7 | .530 | | | | | -.374 | |
| VAS4 | .508 | | | | | -.306 | |
| VAS1 | .400 | | | | | -.325 | |
| PO1 | .472 | | | | -.360 | | |
| PO4 | .454 | .350 | | | | | |
| PO5 | .587 | | | | | | |
| LP5 | .471 | | -.430 | | | | -.392 |
| LP4 | .558 | | -.400 | | | | |
| LP1 | .548 | | | | | | -.303 |
| LP6 | .451 | | -.319 | | -.363 | | |
| II8 | .448 | .468 | -.332 | | .379 | | |
| II5 | | .640 | | | | | |
| II9 | .465 | .337 | | | .317 | | |

Extraction Method: Principal Component Analysis.

a. 7 components extracted.

## Rotated Component Matrix[a]

| | Component | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| RS3 | .679 | | | | | | |
| RS5 | .658 | | | | | | |
| RS2 | .656 | | | | | | |
| RS4 | .520 | | | | | | |
| IS3 | | .771 | | | | | |
| IS4 | | .676 | | | | | |
| IS2 | | .675 | | | | | |
| IS1 | | .600 | | | | | |
| OA6 | | | .686 | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| OA5 | | | .676 | | | | |
| OA4 | | | .582 | | | | |
| VAS2 | | | | .677 | | | |
| VAS7 | | | | .598 | | | |
| VAS4 | | | | .527 | | | |
| VAS1 | | | | .518 | | | |
| PO1 | | | | | .697 | | |
| PO4 | | | | | .561 | | |
| PO5 | | | | | .545 | | |
| LP5 | | | | | | .798 | |
| LP4 | | | | | | .744 | |
| LP1 | | | | | | .442 | |
| II8 | | | | | | | .792 |
| II5 | | | | | | | .691 |
| II9 | | | | | | | .532 |

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 8 iterations.

## Component Transformation Matrix

| Component | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1 | .458 | .418 | .406 | .374 | .343 | .355 | .258 |
| 2 | -.264 | -.475 | -.195 | .208 | .396 | .023 | .683 |
| 3 | .152 | -.003 | -.213 | .440 | .483 | -.589 | -.398 |
| 4 | -.667 | .694 | -.212 | .086 | .126 | .026 | .064 |
| 5 | .400 | .290 | -.439 | .090 | -.447 | -.360 | .474 |
| 6 | .149 | .184 | .117 | -.758 | .457 | -.328 | .196 |
| 7 | -.266 | -.014 | .707 | .182 | -.259 | -.537 | .201 |

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

# APPENDIX E RELIABILITY CRONBACH'S ALPHA- PLI

## Scale: ALL VARIABLES

### Case Processing Summary

| | | N | % |
|---|---|---|---|
| Cases | Valid | 212 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 212 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

### Reliability Statistics

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .606 | .606 | 3 |

### Item Statistics

| | Mean | Std. Deviation | N |
|---|---|---|---|
| II5 | 4.2406 | .70453 | 212 |
| II8 | 4.2311 | .71436 | 212 |
| II9 | 4.1840 | .66684 | 212 |

### Summary Item Statistics

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | 4.219 | 4.184 | 4.241 | .057 | 1.014 | .001 | 3 |

# Reliability

## Scale: ALL VARIABLES

### Case Processing Summary

| | | N | % |
|---|---|---|---|
| Cases | Valid | 212 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 212 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

### Reliability Statistics

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .603 | .601 | 4 |

### Item Statistics

| | Mean | Std. Deviation | N |
|---|---|---|---|
| VAS1 | 3.9670 | .68418 | 212 |
| VAS2 | 3.8349 | .75796 | 212 |
| VAS4 | 3.9340 | .73205 | 212 |
| VAS7 | 4.0283 | .75986 | 212 |

### Summary Item Statistics

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | 3.941 | 3.835 | 4.028 | .193 | 1.050 | .007 | 4 |

## Reliability

## Scale: ALL VARIABLES

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 212 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 212 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .710 | .711 | 4 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| RS2 | 3.8821 | .77292 | 212 |
| RS3 | 3.9292 | .78474 | 212 |
| RS4 | 3.8726 | .77753 | 212 |
| RS5 | 4.0189 | .72832 | 212 |

**Summary Item Statistics**

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | 3.926 | 3.873 | 4.019 | .146 | 1.038 | .004 | 4 |

# Reliability

## Scale: ALL VARIABLES

### Case Processing Summary

| | | N | % |
|---|---|---|---|
| Cases | Valid | 212 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 212 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

### Reliability Statistics

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .754 | .754 | 4 |

### Item Statistics

| | Mean | Std. Deviation | N |
|---|---|---|---|
| IS1 | 4.1132 | .73917 | 212 |
| IS2 | 3.9906 | .73498 | 212 |
| IS3 | 3.9575 | .83926 | 212 |
| IS4 | 3.8962 | .72764 | 212 |

### Summary Item Statistics

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | 3.989 | 3.896 | 4.113 | .217 | 1.056 | .008 | 4 |

# Reliability

## Scale: ALL VARIABLES

### Case Processing Summary

| | | N | % |
|---|---|---|---|
| Cases | Valid | 212 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 212 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

### Reliability Statistics

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .695 | .696 | 4 |

### Item Statistics

| | Mean | Std. Deviation | N |
|---|---|---|---|
| OA3 | 4.0283 | .74729 | 212 |
| OA4 | 3.9245 | .73759 | 212 |
| OA5 | 4.0000 | .70206 | 212 |
| OA6 | 3.8915 | .73667 | 212 |

### Summary Item Statistics

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | 3.961 | 3.892 | 4.028 | .137 | 1.035 | .004 | 4 |

## Reliability

## Scale: ALL VARIABLES

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 212 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 212 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .608 | .608 | 3 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| PO1 | 3.7830 | .75419 | 212 |
| PO4 | 4.0425 | .72405 | 212 |
| PO5 | 3.9670 | .73751 | 212 |

**Summary Item Statistics**

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | 3.931 | 3.783 | 4.042 | .259 | 1.069 | .018 | 3 |

**Scale Statistics**

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 11.7925 | 2.753 | 1.65920 | 3 |

# Reliability

## Scale: ALL VARIABLES

### Case Processing Summary

| | | N | % |
|---|---|---|---|
| Cases | Valid | 212 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 212 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

### Reliability Statistics

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .662 | .661 | 4 |

### Item Statistics

| | Mean | Std. Deviation | N |
|---|---|---|---|
| LP1 | 4.0991 | .71848 | 212 |
| LP4 | 4.0613 | .76723 | 212 |
| LP5 | 4.0613 | .72922 | 212 |
| LP6 | 4.0189 | .74122 | 212 |

### Summary Item Statistics

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | 4.060 | 4.019 | 4.099 | .080 | 1.020 | .001 | 4 |

# APPENDIX F EXPLORATORY FACTOR ANALYSIS-CHALLENGES IN PORT LOGISTICS INTEGRATION

## Factor Analysis

### Correlation Matrix

| | | IN1 | IN2 | OT3 | OT4 | OT5 | MO3 | MO4 | SA1 | SA2 | SA3 | SA4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Correlation | IN1 | 1.000 | .414 | .209 | .054 | .109 | .159 | .107 | .133 | .200 | .186 | .192 |
| | IN2 | .414 | 1.000 | .207 | .081 | .148 | .206 | .287 | .035 | .195 | .096 | .091 |
| | OT3 | .209 | .207 | 1.000 | .342 | .328 | .197 | .120 | .033 | .158 | .049 | .169 |
| | OT4 | .054 | .081 | .342 | 1.000 | .297 | .151 | .151 | .058 | .194 | .021 | .178 |
| | OT5 | .109 | .148 | .328 | .297 | 1.000 | .157 | .206 | -.007 | .117 | .146 | .158 |
| | MO3 | .159 | .206 | .197 | .151 | .157 | 1.000 | .423 | .189 | .120 | .094 | .191 |
| | MO4 | .107 | .287 | .120 | .151 | .206 | .423 | 1.000 | .168 | .230 | .173 | .224 |
| | SA1 | .133 | .035 | .033 | .058 | -.007 | .189 | .168 | 1.000 | .481 | .360 | .339 |
| | SA2 | .200 | .195 | .158 | .194 | .117 | .120 | .230 | .481 | 1.000 | .509 | .302 |
| | SA3 | .186 | .096 | .049 | .021 | .146 | .094 | .173 | .360 | .509 | 1.000 | .400 |
| | SA4 | .192 | .091 | .169 | .178 | .158 | .191 | .224 | .339 | .302 | .400 | 1.000 |

### KMO and Bartlett's Test

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .711 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 414.090 |
| | df | 55 |
| | Sig. | .000 |

### Communalities

| | Initial | Extraction |
|---|---|---|
| IN1 | 1.000 | .720 |
| IN2 | 1.000 | .709 |
| OT3 | 1.000 | .593 |
| OT4 | 1.000 | .599 |
| OT5 | 1.000 | .508 |
| MO3 | 1.000 | .689 |

| | | |
|---|---|---|
| MO4 | 1.000 | .703 |
| SA1 | 1.000 | .592 |
| SA2 | 1.000 | .631 |
| SA3 | 1.000 | .618 |
| SA4 | 1.000 | .458 |

Extraction Method: Principal Component Analysis.

**Total Variance Explained**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 2.954 | 26.853 | 26.853 | 2.954 | 26.853 | 26.853 | 2.217 | 20.154 | 20.154 |
| 2 | 1.584 | 14.398 | 41.252 | 1.584 | 14.398 | 41.252 | 1.691 | 15.371 | 35.526 |
| 3 | 1.204 | 10.944 | 52.195 | 1.204 | 10.944 | 52.195 | 1.459 | 13.263 | 48.789 |
| 4 | 1.079 | 9.805 | 62.000 | 1.079 | 9.805 | 62.000 | 1.453 | 13.212 | 62.000 |
| 5 | .796 | 7.240 | 69.240 | | | | | | |
| 6 | .751 | 6.825 | 76.066 | | | | | | |
| 7 | .654 | 5.949 | 82.015 | | | | | | |
| 8 | .585 | 5.320 | 87.335 | | | | | | |
| 9 | .540 | 4.911 | 92.246 | | | | | | |
| 10 | .479 | 4.350 | 96.596 | | | | | | |
| 11 | .374 | 3.404 | 100.000 | | | | | | |

Extraction Method: Principal Component Analysis.

**Component Matrix[a]**

| | Component 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| IN1 | .471 | .119 | -.509 | .475 |
| IN2 | .462 | .313 | -.595 | .210 |
| OT3 | .454 | .507 | .246 | .263 |
| OT4 | .400 | .406 | .523 | .037 |
| OT5 | .426 | .449 | .344 | .077 |

| | | | | |
|---|---|---|---|---|
| MO3 | .495 | .238 | -.204 | -.588 |
| MO4 | .549 | .162 | -.206 | -.578 |
| SA1 | .529 | -.545 | .069 | -.103 |
| SA2 | .666 | -.395 | .100 | .146 |
| SA3 | .582 | -.502 | .081 | .145 |
| SA4 | .603 | -.245 | .185 | -.012 |

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

**Rotated Component Matrix[a]**

| | Component | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| IN1 | | | | .824 |
| IN2 | | | | .795 |
| OT3 | | .723 | | |
| OT4 | | .755 | | |
| OT5 | | .695 | | |
| MO3 | | | .811 | |
| MO4 | | | .808 | |
| SA1 | .745 | | | |
| SA2 | .765 | | | |
| SA3 | .778 | | | |
| SA4 | .620 | | | |

a. Rotation converged in 5 iterations.

**Component Transformation Matrix**

| Component | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | .690 | .440 | .428 | .384 |
| 2 | -.692 | .634 | .235 | .253 |
| 3 | .192 | .601 | -.279 | -.724 |
| 4 | .095 | .205 | -.827 | .514 |

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

# APPENDIX F RELIABILITY CRONBACH'S ALPHA- CHALLENGES IN IRANIAN PORT LOGISTICS INTEGRATION

## Reliability

## Scale: ALL VARIABLES

**Case Processing Summary**

| | | N | % |
|---|---|---|---|
| Cases | Valid | 212 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 212 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .608 | .608 | 2 |

**Item Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| IN1 | 3.7830 | .95892 | 212 |
| IN2 | 3.9575 | .87248 | 212 |

**Summary Item Statistics**

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Item Means | 3.870 | 3.783 | 3.958 | .175 | 1.046 | .015 | 2 |

# Reliability

## Scale: ALL VARIABLES

### Case Processing Summary

| | | N | % |
|---|---|---|---|
| Cases | Valid | 212 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 212 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

### Reliability Statistics

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .611 | .611 | 3 |

### Item Statistics

| | Mean | Std. Deviation | N |
|---|---|---|---|
| OT3 | 3.7453 | .83253 | 212 |
| OT4 | 3.5236 | .92075 | 212 |
| OT5 | 3.5755 | .88642 | 212 |

### Summary Item Statistics

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Item Means | 3.615 | 3.524 | 3.745 | .222 | 1.063 | .013 | 3 |

# Reliability

## Scale: ALL VARIABLES

### Case Processing Summary

| | | N | % |
|---|---|---|---|
| Cases | Valid | 212 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 212 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

### Reliability Statistics

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .587 | .594 | 2 |

### Item Statistics

| | Mean | Std. Deviation | N |
|---|---|---|---|
| MO3 | 3.5472 | .99888 | 212 |
| MO4 | 3.9528 | .82476 | 212 |

### Summary Item Statistics

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Item Means | 3.750 | 3.547 | 3.953 | .406 | 1.114 | .082 | 2 |

# Reliability

## Scale: ALL VARIABLES

### Case Processing Summary

| | | N | % |
|---|---|---|---|
| Cases | Valid | 212 | 100.0 |
| | Excluded[a] | 0 | .0 |
| | Total | 212 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

### Reliability Statistics

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .723 | .726 | 4 |

### Item Statistics

| | Mean | Std. Deviation | N |
|---|---|---|---|
| SA1 | 4.0330 | .83402 | 212 |
| SA2 | 4.1226 | .78133 | 212 |
| SA3 | 4.0991 | .73155 | 212 |
| SA4 | 4.0236 | .85121 | 212 |

### Summary Item Statistics

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | 4.070 | 4.024 | 4.123 | .099 | 1.025 | .002 | 4 |

# APPENDIX G CFA- PLI

**Notes for Group (Group number 1)**

The model is recursive.
Sample size = 212

Number of variables in your model: 55
Number of observed variables: 24
Number of unobserved variables: 31
Number of exogenous variables: 31
Number of endogenous variables: 24

| | Weights | Covariances | Variances | Means | Intercepts | Total |
|---|---|---|---|---|---|---|
| Fixed | 31 | 0 | 0 | 0 | 0 | 31 |
| Labeled | 0 | 0 | 0 | 0 | 0 | 0 |
| Unlabeled | 17 | 21 | 31 | 0 | 0 | 69 |
| Total | 48 | 21 | 31 | 0 | 0 | 100 |

Number of distinct sample moments: 300
Number of distinct parameters to be estimated: 69
Degrees of freedom (300 - 69): 231

**Estimates (Group number 1 - Default model)**

**Scalar Estimates (Group number 1 - Default model)**

**Maximum Likelihood Estimates**

**Regression Weights: (Group number 1 - Default model)**

| | | | Estimate | S.E. | C.R. | P | Label |
|---|---|---|---|---|---|---|---|
| RS4 | <--- | Resource_Sharing | 1.000 | | | | |
| RS2 | <--- | Resource_Sharing | 1.365 | .218 | 6.255 | *** | |
| RS5 | <--- | Resource_Sharing | 1.148 | .194 | 5.930 | *** | |
| RS3 | <--- | Resource_Sharing | 1.277 | .212 | 6.027 | *** | |
| IS1 | <--- | Institutional_Support | 1.000 | | | | |
| IS2 | <--- | Institutional_Support | .842 | .099 | 8.458 | *** | |
| IS4 | <--- | Institutional_Support | .684 | .098 | 7.001 | *** | |
| IS3 | <--- | Institutional_Support | .988 | .114 | 8.674 | *** | |
| OA3 | <--- | Organisational_Activities | 1.000 | | | | |
| OA4 | <--- | Organisational_Activities | .807 | .121 | 6.682 | *** | |
| OA5 | <--- | Organisational_Activities | .896 | .118 | 7.595 | *** | |
| OA6 | <--- | Organisational_Activities | .793 | .120 | 6.587 | *** | |
| PO5 | <--- | Process_Operation | 1.000 | | | | |
| PO4 | <--- | Process_Operation | .771 | .129 | 5.993 | *** | |

| | | | Estimate | S.E. | C.R. | P | Label |
|---|---|---|---|---|---|---|---|
| PO1 | <--- | Process_Operation | .810 | .134 | 6.032 | *** | |
| VAS4 | <--- | Value_Added_Services | 1.000 | | | | |
| VAS7 | <--- | Value_Added_Services | 1.125 | .192 | 5.863 | *** | |
| VAS2 | <--- | Value_Added_Services | 1.018 | .184 | 5.520 | *** | |
| LP1 | <--- | Logistics_Practices | 1.000 | | | | |
| LP4 | <--- | Logistics_Practices | 1.323 | .206 | 6.421 | *** | |
| LP5 | <--- | Logistics_Practices | 1.071 | .179 | 5.967 | *** | |
| II9 | <--- | Information_Integration | 1.000 | | | | |
| II8 | <--- | Information_Integration | .852 | .161 | 5.286 | *** | |
| VAS1 | <--- | Value_Added_Services | .743 | .156 | 4.758 | *** | |

**Standardized Regression Weights: (Group number 1 - Default model)**

| | | | Estimate |
|---|---|---|---|
| RS4 | <--- | Resource_Sharing | .507 |
| RS2 | <--- | Resource_Sharing | .699 |
| RS5 | <--- | Resource_Sharing | .624 |
| RS3 | <--- | Resource_Sharing | .641 |
| IS1 | <--- | Institutional_Support | .767 |
| IS2 | <--- | Institutional_Support | .652 |
| IS4 | <--- | Institutional_Support | .536 |
| IS3 | <--- | Institutional_Support | .673 |
| OA3 | <--- | Organisational_Activities | .667 |
| OA4 | <--- | Organisational_Activities | .548 |
| OA5 | <--- | Organisational_Activities | .645 |
| OA6 | <--- | Organisational_Activities | .539 |
| PO5 | <--- | Process_Operation | .676 |
| PO4 | <--- | Process_Operation | .538 |
| PO1 | <--- | Process_Operaon | .533 |
| VAS4 | <--- | Value_Added_Services | .548 |
| VAS7 | <--- | Value_Added_Services | .582 |
| VAS2 | <--- | Value_Added_Services | .534 |
| LP1 | <--- | Logistics_Practices | .567 |
| LP4 | <--- | Logistics_Practices | .692 |
| LP5 | <--- | Logistics_Practices | .592 |
| II9 | <--- | Information_Integration | .645 |
| II8 | <--- | Information_Integration | .700 |
| VAS1 | <--- | Value_Added_Services | .432 |

**Covariances: (Group number 1 - Default model)**

| | | | Estimate | S.E. | C.R. | P | Label |
|---|---|---|---|---|---|---|---|
| Resource_Sharing | <--> | Institutional_Support | .138 | .029 | 4.684 | *** | |
| Institutional_Support | <--> | Organisational_Activities | .196 | .035 | 5.681 | *** | |

| | | | Estimate | S.E. | C.R. | P | Label |
|---|---|---|---|---|---|---|---|
| Resource_Sharing | <--> | Organisational_Activities | .150 | .031 | 4.890 | *** | |
| Organisational_Activities | <--> | Value_Added_Services | .129 | .028 | 4.572 | *** | |
| Process_Operation | <--> | Value_Added_Services | .162 | .032 | 5.029 | *** | |
| Process_Operation | <--> | Logistics_Practices | .114 | .027 | 4.193 | *** | |
| Process_Operation | <--> | Information_Integration | .100 | .029 | 3.442 | *** | |
| Logistics_Practices | <--> | Information_Integration | .110 | .026 | 4.183 | *** | |
| Value_Added_Services | <--> | Information_Integration | .115 | .027 | 4.258 | *** | |
| Organisational_Activities | <--> | Process_Operation | .165 | .033 | 5.059 | *** | |
| Organisational_Activities | <--> | Logistics_Practices | .145 | .030 | 4.894 | *** | |
| Organisational_Activities | <--> | Information_Integration | .133 | .030 | 4.484 | *** | |
| Institutional_Support | <--> | Value_Added_Services | .144 | .030 | 4.783 | *** | |
| Institutional_Support | <--> | Process_Operation | .166 | .033 | 4.955 | *** | |
| Institutional_Support | <--> | Logistics_Practices | .138 | .029 | 4.711 | *** | |
| Institutional_Support | <--> | Information_Integration | .098 | .029 | 3.328 | *** | |
| Resource_Sharing | <--> | Value_Added_Services | .101 | .024 | 4.156 | *** | |
| Resource_Sharing | <--> | Process_Operation | .122 | .028 | 4.372 | *** | |
| Resource_Sharing | <--> | Logistics_Practices | .091 | .023 | 3.991 | *** | |
| Resource_Sharing | <--> | Information_Integration | .097 | .025 | 3.918 | *** | |
| Value_Added_Services | <--> | Logistics_Practices | .094 | .023 | 3.989 | *** | |

**Correlations: (Group number 1 - Default model)**

| | | | Estimate |
|---|---|---|---|
| Resource_Sharing | <--> | Institutional_Support | .617 |
| Institutional_Support | <--> | Organisational_Activities | .692 |
| Resource_Sharing | <--> | Organisational_Activities | .761 |
| Organisational_Activities | <--> | Value_Added_Services | .651 |
| Process_Operation | <--> | Value_Added_Services | .820 |

| | | | Estimate |
|---|---|---|---|
| Process_Operation | <--> | Logistics_Practices | .565 |
| Process_Operation | <--> | Information_Integration | .404 |
| Logistics_Practices | <--> | Information_Integration | .543 |
| Value_Added_Services | <--> | Information_Integration | .582 |
| Organisational_Activities | <--> | Process_Operation | .663 |
| Organisational_Activities | <--> | Logistics_Practices | .714 |
| Organisational_Activities | <--> | Information_Integration | .534 |
| Institutional_Support | <--> | Value_Added_Services | .642 |
| Institutional_Support | <--> | Process_Operation | .586 |
| Institutional_Support | <--> | Logistics_Practices | .600 |
| Institutional_Support | <--> | Information_Integration | .345 |
| Resource_Sharing | <--> | Value_Added_Services | .647 |
| Resource_Sharing | <--> | Process_Operation | .620 |
| Resource_Sharing | <--> | Logistics_Practices | .569 |
| Resource_Sharing | <--> | Information_Integration | .494 |
| Value_Added_Services | <--> | Logistics_Practices | .582 |

**Variances: (Group number 1 - Default model)**

| | Estimate | S.E. | C.R. | P | Label |
|---|---|---|---|---|---|
| Resource_Sharing | .155 | .044 | 3.517 | *** | |
| Institutional_Support | .322 | .054 | 5.919 | *** | |
| Organisational_Activities | .250 | .051 | 4.926 | *** | |
| Process_Operation | .248 | .054 | 4.566 | *** | |
| Value_Added_Services | .157 | .043 | 3.678 | *** | |
| Logistics_Practices | .165 | .043 | 3.833 | *** | |
| Information_Integration | .249 | .058 | 4.287 | *** | |
| e4 | .446 | .048 | 9.316 | *** | |
| e3 | .305 | .040 | 7.600 | *** | |
| e2 | .323 | .038 | 8.510 | *** | |
| e8 | .221 | .033 | 6.691 | *** | |
| e7 | .309 | .037 | 8.469 | *** | |
| e6 | .376 | .040 | 9.309 | *** | |
| e5 | .386 | .047 | 8.272 | *** | |
| e12 | .306 | .038 | 8.118 | *** | |
| e11 | .379 | .041 | 9.181 | *** | |
| e10 | .290 | .034 | 8.467 | *** | |
| e9 | .383 | .041 | 9.233 | *** | |
| e1 | .360 | .043 | 8.304 | *** | |
| e19 | .293 | .043 | 6.891 | *** | |
| e18 | .374 | .042 | 8.803 | *** | |
| e17 | .403 | .046 | 8.765 | *** | |
| e15 | .376 | .043 | 8.843 | *** | |
| e14 | .376 | .045 | 8.416 | *** | |
| e13 | .409 | .046 | 8.917 | *** | |
| e22 | .349 | .041 | 8.585 | *** | |

| | Estimate | S.E. | C.R. | P | Label |
|---|---|---|---|---|---|
| e21 | .298 | .044 | 6.695 | *** | |
| e20 | .340 | .041 | 8.273 | *** | |
| e26 | .194 | .047 | 4.104 | *** | |
| e24 | .327 | .045 | 7.309 | *** | |
| e16 | .379 | .040 | 9.518 | *** | |

**Matrices (Group number 1 - Default model)**

**Residual Covariances (Group number 1 - Default model)**

| | | | M.I. | Par Change |
|---|---|---|---|---|
| e21 | <--> | e20 | 5.166 | .060 |
| e22 | <--> | Logistics_Practices | 4.054 | -.033 |
| e14 | <--> | e24 | 12.228 | -.099 |
| e15 | <--> | e22 | 7.615 | -.077 |
| e19 | <--> | e20 | 8.304 | -.076 |
| e10 | <--> | e14 | 5.544 | .061 |
| e10 | <--> | e9 | 5.606 | .060 |
| e6 | <--> | e24 | 13.522 | .101 |
| e6 | <--> | e5 | 5.716 | .070 |
| e3 | <--> | e12 | 6.253 | .064 |
| e4 | <--> | Value_Added_Services | 4.744 | -.041 |
| e4 | <--> | Process_Operation | 21.489 | .113 |
| e4 | <--> | e17 | 11.517 | .109 |
| e4 | <--> | e19 | 5.971 | .071 |
| e4 | <--> | e12 | 6.094 | -.071 |

| | M.I. | Par Change |
|---|---|---|

| | | | M.I. | Par Change |
|---|---|---|---|---|
| II8 | <--- | VAS7 | 6.044 | -.140 |
| II8 | <--- | IS4 | 10.989 | .197 |
| LP5 | <--- | PO5 | 5.792 | -.142 |
| VAS7 | <--- | II8 | 7.070 | -.168 |
| PO1 | <--- | RS4 | 8.065 | .169 |
| PO5 | <--- | LP5 | 4.220 | -.119 |
| PO5 | <--- | RS4 | 4.906 | .120 |
| OA3 | <--- | RS2 | 4.147 | .110 |
| IS4 | <--- | II8 | 9.789 | .193 |
| RS2 | <--- | OA3 | 4.083 | .115 |
| RS4 | <--- | PO1 | 12.570 | .225 |
| RS4 | <--- | PO5 | 6.988 | .172 |

| Iteration | | Negative eigenvalues | Condition # | Smallest eigenvalue | Diameter | F | NTries | Ratio |
|---|---|---|---|---|---|---|---|---|
| 0 | e | 27 | | -.330 | 9999.000 | 1633.671 | 0 | 9999.000 |

| Iteration | | Negative eigenvalues | Condition # | Smallest eigenvalue | Diameter | F | NTries | Ratio |
|---|---|---|---|---|---|---|---|---|
| 1 | e* | 6 | | -.112 | 2.843 | 657.827 | 20 | .607 |
| 2 | e* | 0 | 706.928 | | .865 | 462.935 | 5 | .682 |
| 3 | e | 0 | 260.655 | | .807 | 365.789 | 3 | .000 |
| 4 | e | 0 | 288.185 | | .911 | 300.529 | 1 | 1.009 |
| 5 | e | 0 | 408.876 | | .441 | 291.657 | 1 | 1.014 |
| 6 | e | 0 | 497.060 | | .105 | 290.865 | 1 | 1.028 |
| 7 | e | 0 | 506.048 | | .010 | 290.862 | 1 | 1.007 |
| 8 | e | 0 | 511.335 | | .000 | 290.862 | 1 | 1.000 |

| Model | NPAR | CMIN | DF | P | CMIN/DF |
|---|---|---|---|---|---|
| Default model | 73 | 352.010 | 278 | .002 | 1.266 |
| Saturated model | 351 | .000 | 0 | | |
| Independence model | 26 | 1601.387 | 325 | .000 | 4.927 |

| Model | RMR | GFI | AGFI | PGFI |
|---|---|---|---|---|
| Default model | .028 | .890 | .861 | .705 |
| Saturated model | .000 | 1.000 | | |
| Independence model | .131 | .396 | .348 | .367 |

| Model | NFI Delta1 | RFI rho1 | IFI Delta2 | TLI rho2 | CFI |
|---|---|---|---|---|---|
| Default model | .780 | .743 | .944 | .932 | .942 |
| Saturated model | 1.000 | | 1.000 | | 1.000 |
| Independence model | .000 | .000 | .000 | .000 | .000 |

| Model | PRATIO | PNFI | PCFI |
|---|---|---|---|
| Default model | .837 | .672 | .795 |
| Saturated model | .000 | .000 | .000 |
| Independence model | 1.000 | .000 | .000 |

| Model | NCP | LO 90 | HI 90 |
|---|---|---|---|
| Default model | 59.862 | 20.336 | 107.541 |
| Saturated model | .000 | .000 | .000 |
| Independence model | 1199.535 | 1082.924 | 1323.629 |

| Model | FMIN | F0 | LO 90 | HI 90 |
|---|---|---|---|---|
| Default model | 1.378 | .284 | .096 | .510 |
| Saturated model | .000 | .000 | .000 | .000 |
| Independence model | 6.993 | 5.685 | 5.132 | 6.273 |

| Model | RMSEA | LO 90 | HI 90 | PCLOSE |
|---|---|---|---|---|
| Default model | .036 | .023 | .046 | .988 |
| Independence model | .136 | .130 | .143 | .000 |

| Model | AIC | BCC | BIC | CAIC |
|---|---|---|---|---|
| Default model | 428.862 | 447.410 | 660.466 | 729.466 |
| Saturated model | 600.000 | 680.645 | 1606.976 | 1906.976 |
| Independence model | 1523.535 | 1529.986 | 1604.093 | 1628.093 |

| Model | ECVI | LO 90 | HI 90 | MECVI |
|---|---|---|---|---|
| Default model | 2.033 | 1.845 | 2.258 | 2.120 |
| Saturated model | 2.844 | 2.844 | 2.844 | 3.226 |
| Independence model | 7.221 | 6.668 | 7.809 | 7.251 |

| Model | HOELTER .05 | HOELTER .01 |
|---|---|---|
| Default model | 195 | 206 |
| Independence model | 46 | 48 |

| | |
|---|---|
| Minimization: | .040 |
| Miscellaneous: | .563 |
| Bootstrap: | .000 |
| Total: | .603 |

# APPENDIX H CFA- CHALLENGES IN PORT LOGISTICS INTEGRATION

**Notes for Group (Group number 1)**

The model is recursive.
Sample size = 212

| | |
|---|---|
| Number of variables in your model: | 26 |
| Number of observed variables: | 11 |
| Number of unobserved variables: | 15 |
| Number of exogenous variables: | 15 |
| Number of endogenous variables: | 11 |

| | Weights | Covariances | Variances | Means | Intercepts | Total |
|---|---|---|---|---|---|---|
| Fixed | 15 | 0 | 0 | 0 | 0 | 15 |
| Labeled | 0 | 0 | 0 | 0 | 0 | 0 |
| Unlabeled | 7 | 6 | 15 | 0 | 0 | 28 |
| Total | 22 | 6 | 15 | 0 | 0 | 43 |

| | |
|---|---|
| Number of distinct sample moments: | 66 |
| Number of distinct parameters to be estimated: | 28 |
| Degrees of freedom (66 - 28): | 38 |

**Estimates (Group number 1 - Default model)**

**Scalar Estimates (Group number 1 - Default model)**

**Maximum Likelihood Estimates**

**Regression Weights: (Group number 1 - Default model)**

| | | | Estimate | S.E. | C.R. | P | Label |
|---|---|---|---|---|---|---|---|
| IN2 | <--- | Infrustructure | 1.000 | | | | |
| IN1 | <--- | Infrustructure | .857 | .227 | 3.770 | *** | |
| OT5 | <--- | Operational_Technical | .989 | .222 | 4.457 | *** | |
| OT4 | <--- | Operational_Technical | 1.000 | | | | |
| MO4 | <--- | Managerial_Organisational | 1.000 | | | | |
| SA4 | <--- | Sancations | 1.000 | | | | |
| SA3 | <--- | Sancations | 1.108 | .186 | 5.956 | *** | |
| SA2 | <--- | Sancations | 1.321 | .216 | 6.130 | *** | |
| SA1 | <--- | Sancations | 1.146 | .201 | 5.694 | *** | |
| MO3 | <--- | Managerial_Organisational | 1.035 | .234 | 4.417 | *** | |
| OT3 | <--- | Operational_Technical | 1.056 | .235 | 4.495 | *** | |

**Standardized Regression Weights: (Group number 1 - Default model)**

| | | | Estimate |
|---|---|---|---|
| IN2 | <--- | Infrustructure | .734 |
| IN1 | <--- | Infrustructure | .564 |
| OT5 | <--- | Operational_Technical | .541 |
| OT4 | <--- | Operational_Technical | .545 |

| | | | Estimate |
|---|---|---|---|
| MO4 | <--- | Managerial_Organisational | .713 |
| SA4 | <--- | Sancations | .675 |
| SA3 | <--- | Sancations | .591 |
| SA2 | <--- | Sancations | .864 |
| SA1 | <--- | Sancations | .540 |
| MO3 | <--- | Managerial_Organisational | .593 |
| OT3 | <--- | Operational_Technical | .619 |

**Covariances: (Group number 1 - Default model)**

| | | | Estimate | S.E. | C.R. | P | Label |
|---|---|---|---|---|---|---|---|
| Infrustructure | <--> | Operational_Technical | .117 | .041 | 2.859 | .004 | |
| Infrustructure | <--> | Managerial_Organisational | .173 | .047 | 3.660 | *** | |
| Infrustructure | <--> | Sancations | .088 | .032 | 2.781 | .005 | |
| Operational_Technical | <--> | Managerial_Organisational | .121 | .039 | 3.099 | .002 | |
| Operational_Technical | <--> | Sancations | .062 | .025 | 2.414 | .016 | |
| Managerial_Organisational | <--> | Sancations | .102 | .031 | 3.288 | .001 | |

**Correlations: (Group number 1 - Default model)**

| | | | Estimate |
|---|---|---|---|
| Infrustructure | <--> | Operational_Technical | .377 |
| Infrustructure | <--> | Managerial_Organisational | .472 |
| Infrustructure | <--> | Sancations | .318 |
| Operational_Technical | <--> | Managerial_Organisational | .427 |
| Operational_Technical | <--> | Sancations | .287 |
| Managerial_Organisational | <--> | Sancations | .403 |

**Variances: (Group number 1 - Default model)**

| | Estimate | S.E. | C.R. | P | Label |
|---|---|---|---|---|---|
| Infrustructure | .402 | .121 | 3.310 | *** | |
| Operational_Technical | .240 | .078 | 3.082 | .002 | |
| Managerial_Organisational | .335 | .092 | 3.641 | *** | |
| Sancations | .192 | .055 | 3.483 | *** | |
| e2 | .356 | .108 | 3.287 | .001 | |
| e1 | .620 | .096 | 6.424 | *** | |
| e11 | .547 | .074 | 7.432 | *** | |
| e9 | .604 | .079 | 7.657 | *** | |
| e16 | .342 | .080 | 4.299 | *** | |
| e20 | .529 | .058 | 9.042 | *** | |
| e19 | .297 | .040 | 7.460 | *** | |

| | Estimate | S.E. | C.R. | P | Label |
|---|---|---|---|---|---|
| e18 | .272 | .045 | 5.993 | *** | |
| e17 | .440 | .053 | 8.288 | *** | |
| e14 | .634 | .099 | 6.406 | *** | |
| e12 | .423 | .069 | 6.117 | *** | |

**Matrices (Group number 1 - Default model)**

**Residual Covariances (Group number 1 - Default model)**

| | OT3 | MO3 | SA1 | SA2 | SA3 | SA4 | MO4 | OT4 | OT5 | IN1 | IN2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| OT3 | .000 | | | | | | | | | | |
| MO3 | .031 | .000 | | | | | | | | | |
| SA1 | -.052 | .035 | .000 | | | | | | | | |
| SA2 | .016 | -.047 | .021 | .000 | | | | | | | |
| SA3 | -.042 | -.049 | -.026 | .008 | .000 | | | | | | |
| SA4 | .054 | .056 | .019 | -.054 | .035 | .000 | | | | | |
| MO4 | -.045 | .000 | -.003 | .012 | -.010 | .054 | .000 | | | | |
| OT4 | .008 | .013 | -.026 | .057 | -.054 | .077 | -.007 | .000 | | | |
| OT5 | -.010 | .014 | -.075 | .000 | .026 | .058 | .030 | .004 | .000 | | |
| IN1 | .061 | -.002 | .019 | .049 | .046 | .080 | -.064 | -.053 | -.007 | .000 | |
| IN2 | .026 | .000 | -.076 | .016 | -.037 | -.021 | .032 | -.052 | -.002 | .000 | .000 |

**Standardized Residual Covariances (Group number 1 - Default model)**

| | OT3 | MO3 | SA1 | SA2 | SA3 | SA4 | MO4 | OT4 | OT5 | IN1 | IN2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| OT3 | .000 | | | | | | | | | | |

| | OT3 | MO3 | SA1 | SA2 | SA3 | SA4 | MO4 | OT4 | OT5 | IN1 | IN2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MO3 | .535 | .000 | | | | | | | | | |
| SA1 | -1.084 | .608 | .000 | | | | | | | | |
| SA2 | .359 | -.859 | .423 | .000 | | | | | | | |
| SA3 | -1.000 | -.965 | -.573 | .186 | .000 | | | | | | |
| SA4 | 1.113 | .949 | .380 | -1.110 | .766 | .000 | | | | | |
| MO4 | -.946 | .000 | -.053 | .267 | -.230 | 1.120 | .000 | | | | |
| OT4 | .137 | .204 | -.501 | 1.155 | -1.164 | 1.431 | -.124 | .000 | | | |
| OT5 | -.178 | .232 | -1.467 | -.002 | .593 | 1.111 | .595 | .067 | .000 | | |
| IN1 | 1.097 | -.028 | .352 | .949 | .951 | 1.430 | -1.167 | -.866 | -.126 | .000 | |
| IN2 | .515 | -.006 | -1.516 | .332 | -.839 | -.417 | .638 | -.941 | -.032 | .000 | .000 |

| | | | M.I. | Par Change |
|---|---|---|---|---|
| e20 | <--> | e18 | 6.480 | -.081 |
| e1 | <--> | e16 | 4.193 | -.087 |

| | M.I. | Par Change |
|---|---|---|

| | | | M.I. | Par Change |
|---|---|---|---|---|
| SA1 | <--- | OT5 | 4.142 | -.113 |
| SA2 | <--- | SA4 | 4.512 | -.107 |
| SA4 | <--- | Operational_Technical | 4.046 | .272 |

| Iteration | | Negative eigenvalues | Condition # | Smallest eigenvalue | Diameter | F | NTries | Ratio |
|---|---|---|---|---|---|---|---|---|
| 0 | e | 9 | | -.239 | 9999.000 | 533.788 | 0 | 9999.000 |
| 1 | e | 1 | | -.119 | 2.209 | 212.287 | 21 | .476 |

| Iteration | | Negative eigenvalues | Condition # | Smallest eigenvalue | Diameter | F | NTries | Ratio |
|---|---|---|---|---|---|---|---|---|
| 2 | e | 0 | 172.184 | | .964 | 108.209 | 5 | .676 |
| 3 | e | 0 | 404.057 | | 1.227 | 92.229 | 1 | .349 |
| 4 | e | 1 | | -.007 | .796 | 69.389 | 2 | .000 |
| 5 | e | 0 | 280.003 | | .483 | 57.988 | 7 | 1.004 |
| 6 | e | 0 | 229.189 | | .252 | 56.890 | 1 | .952 |
| 7 | e | 0 | 218.964 | | .038 | 56.826 | 1 | 1.007 |
| 8 | e | 0 | 220.370 | | .003 | 56.826 | 1 | 1.002 |
| 9 | e | 0 | 220.354 | | .000 | 56.826 | 1 | 1.000 |

| Model | NPAR | CMIN | DF | P | CMIN/DF |
|---|---|---|---|---|---|
| Default model | 29 | 42.209 | 37 | .006 | 1.141 |
| Saturated model | 66 | .000 | 0 | | |
| Independence model | 11 | 423.114 | 55 | .000 | 7.693 |

| Model | RMR | GFI | AGFI | PGFI |
|---|---|---|---|---|
| Default model | .032 | .966 | .939 | .542 |
| Saturated model | .000 | 1.000 | | |
| Independence model | .147 | .668 | .601 | .556 |

| Model | NFI Delta1 | RFI rho1 | IFI Delta2 | TLI rho2 | CFI |
|---|---|---|---|---|---|
| Default model | .900 | .852 | .987 | .979 | .986 |
| Saturated model | 1.000 | | 1.000 | | 1.000 |
| Independence model | .000 | .000 | .000 | .000 | .000 |

| Model | PRATIO | PNFI | PCFI |
|---|---|---|---|
| Default model | .691 | .598 | .656 |
| Saturated model | .000 | .000 | .000 |
| Independence model | 1.000 | .000 | .000 |

| Model | NCP | LO 90 | HI 90 |
|---|---|---|---|
| Default model | 18.826 | 2.475 | 43.137 |
| Saturated model | .000 | .000 | .000 |
| Independence model | 368.114 | 306.377 | 437.330 |

| Model | FMIN | F0 | LO 90 | HI 90 |
|---|---|---|---|---|
| Default model | .269 | .089 | .012 | .204 |
| Saturated model | .000 | .000 | .000 | .000 |
| Independence model | 2.005 | 1.745 | 1.452 | 2.073 |

| Model | RMSEA | LO 90 | HI 90 | PCLOSE |
|---|---|---|---|---|
| Default model | .02 | .000 | .057 | .884 |
| Independence model | .178 | .162 | .194 | .000 |

| Model | AIC | BCC | BIC | CAIC |
|---|---|---|---|---|
| Default model | 112.826 | 116.203 | 206.810 | 234.810 |
| Saturated model | 132.000 | 139.960 | 353.535 | 419.535 |
| Independence model | 445.114 | 446.441 | 482.037 | 493.037 |

| Model | ECVI | LO 90 | HI 90 | MECVI |
|---|---|---|---|---|
| Default model | .535 | .457 | .650 | .551 |
| Saturated model | .626 | .626 | .626 | .663 |
| Independence model | 2.110 | 1.817 | 2.438 | 2.116 |

| Model | HOELTER .05 | HOELTER .01 |
|---|---|---|
| Default model | 199 | 228 |
| Independence model | 37 | 42 |

Minimization: .008
Miscellaneous: .184
Bootstrap: .000
Total: .192